TROPICAL AGRICULTURE

THE OFFICIAL JOURNAL OF THE
IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

VOL. II No. 5. TRINIDAD, MAY, 1925. PRICE 6d.

CONTENTS.

	PAGE.
Diversification of Crops	93
Sugar-Cane Experiments	95
The cultivation of Castor Seed	96
Cotton Notes	96
Honey in Palestine	97
Entomological Notes	97
Mycological Notes	99
Sugar Machinery	101
Government Botanic Gardens	102
Tropical World	104
Synthetic Farmyard Manure	108
Rainfall and Crop Yields	109
Chemical Notes	110
Book Reviews	112
The College Sugar Factory	114
College News	115
Trend of the Markets	116
Rubber	116

TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C., England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed in signed articles are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Correspondence, which will be replied to, is invited on all matters pertaining to tropical agriculture, science and development.

DIVERSIFICATION OF CROPS.

THE recent depression in a number of the main tropical products brings into prominence the fact that one-crop areas are based upon an unstable economic foundation. While the main crop is in wide demand at remunerative prices the whole country prospers, but immediately any disaster overtakes it the whole area is thrown into a profound depression of a more or less permanent nature. There is much to be said for the specialisation of areas, but the inherent danger should constantly be borne in mind by planters and those responsible for the administration of the country. For a commodity to establish itself upon the market it must be in wide or increasing demand. That granted, it is essential that there should be a regular supply for export. For this purpose the crop must be cultivated on a large scale. Once firmly established on the market little difficulty is experienced in persuading the inhabitants to take up its cultivation, and in this manner whole countries have become, in the main, dependent on a single crop.

The classical example of a one-crop area is the coffee industry of Ceylon. When, after the abolition of slavery and the withdrawal of the monopoly of the English East India Company, the economic outlook was turned from the West to the East, Ceylon took the place of the West Indies as the most favoured field of investment for British capital. Coffee cultivation was extended upon a large scale until it dominated the market of that era. In 1868 a disease of the coffee plant (the *Hemeliea vastatrix*) began to make its presence felt. At first it was accepted as being a normal visitation of disease and no special measures were taken to cope with it. As its ravages spread the planters awoke to the fact that this was no ordinary disease but one which threatened the very existence of the industry. Strenuous efforts were made to cope with it, but they proved fruitless and planters were reluctantly forced to realise that their only hope lay in the cultivation of other crops. Cinchona, for example, was tried and production rapidly rose from 11,547 lb. of bark in 1872 to 15,892,078 lb. in 1887. The wild product was soon ousted and the extensive cultivation of cinchona in Ceylon was one of the factors which resulted in that extremely useful drug, quinine, becoming available for mankind in general. It was realised, however, that the market was sufficiently limited to prevent it from wholly taking the place of coffee. Meantime efforts had been directed with varying success to products such as cardamoms, cinnamon, coconuts, &c., but salvation was eventually found in the cultivation of tea, which, owing to its long tap root, thrives upon exhausted coffee plantations. Owing to the failure of coffee, investors were particularly cautious concerning investments in new products and consequently tea was introduced upon sound economic lines, and the era of speculation which characterised the growth of the Indian industry was, in large measure, avoided. While the tea industry of Ceylon has assumed enormous dimensions it is of interest and of significance to note that since the beginning of the present century planters have been turning their attention to crops other than tea, such as rubber and coconuts, so that while the failure of the Ceylon tea industry would have a very serious reaction upon the prosperity of the

island the effect would not be so disastrous as in the case of the failure of the coffee industry.

Recent examples of the over-production of tropical crops at remunerative prices due to the extreme specialisation of certain areas are not lacking. The most obvious example is that of the rubber industry of Malaya and Ceylon. As recently as 1900, of the total world production of 53,890 tons of rubber no less than 53,886 tons came from Brazil and Africa where it was gathered from the primitive forests by crude and uneconomic methods. The rubber industry has been built up by the astonishing growth of the motor car industry. A few Englishmen of conspicuous ability and foresight conceived the idea of the rubber planting industry and within a very few years the wild rubber collecting industry had been ousted from the markets. In spite of the fact that rubber trees take a considerable period before they reach maturity it is astonishing to note how up to 1919 the demand kept pace with the supply although at continually falling prices. The year 1919 witnessed the introduction of the cord tyre, with its correspondingly larger life, with the result that the rubber industry received a sudden check and prices fell below the cost of production.

Many rubber producers in Malaya and Ceylon banded themselves together to restrict output with the object of raising prices to higher and more profitable levels. The real remedy, however, lies in a greater diversification of agriculture in order that the risk of depression arising from the failure of one particular crop may be minimised. This fact has been forcibly brought home to the planters of Malaya and in that country, as in Ceylon half a century ago, strenuous efforts are being made to introduce crops of a more profitable nature (for further information the reader is referred to Vol. II No. 3 pp. 62-4 of this Journal). In one case disaster followed the spread of a terrible parasitic fungus and in the second was attendant upon over-production at profitable prices. The causes were diverse, but the economic effect and remedy the same.

Nor is rubber alone in this respect. Cocoa has recently undergone similar hardships. Here again a wonderful industry has been built up as the result of British enterprise and capital; the production of the Gold Coast, for example, rising from 39,000 metric tons in 1912 to 194,000 metric tons in 1923. Recently prices fell to such an extent that many estates became seriously encumbered with debts and mortgages. This may be due to a variety of causes—over-production, under-consumption, primitive methods of cultivation, or speculation. The remedy may lie in a producer's co-operative alliance to extend the sales of cocoa, limit the extent of production, and improve methods of production, or by publishing reliable information regarding stocks and supplies of cocoa. One, or more in combination, may have the desired effect, but the only certain remedy lies in a greater diversification of crops. As far as the Gold Coast is concerned it is unfortunate that the introduction to permanent commercial cultivation should have been *via* cocoa for this crop thrives even with neglect whereas other crops require constant attention and considerable skill. In other cocoa producing countries, however, the average standard of the general cultivator is much higher and the introduction of other crops is not attended by the same difficulties. Yet it is interesting to note that the Gold Coast Authorities are fully alive to the gravity of the situation and are conducting exhaustive investigations into the possibility of introducing other crops (*see Tropical Agriculture* Vol. II., No. 2 pp. 39-41.)

Brazil, too, has had to face the possibility of an over-production of coffee and has sought a remedy in the control of output. It is noteworthy that all these crops involve the sinking of a considerable quantity of money before any return can be expected. In the case of annual crops the adjustment of supply to demand is a matter of comparatively easy accomplishment and it is extremely doubtful if one can point to a single annual crop which has been subjected to a long and continued period of depression. It is extraordinary to note that few tropical planters have attempted to cut the Gordian knot in the case of long standing crops by turning their attention to other crops. This neglect is all the more surprising when one realises that a large number of minor crops exist in the tropics which could be developed into profitable industries if they received adequate attention and co-operation. It is to be hoped that the British planting community, as in other directions, will be the first to realise the potentialities of these crops and the first to reap the handsome rewards which await the pioneers.

Planters should realise that it is far more satisfactory to conduct an enquiry than a post mortem examination. *Verbum sapienti.*

The danger is again illustrated on a smaller scale by the disastrous failure of the lime industry in Montserrat which has been brought about by an evil combination of circumstances; disease, hurricanes, competition of the Italian lemon industry, &c. Such disasters cannot, unfortunately, be foreseen and even if foreseen it is difficult to ensure that adequate precautions are taken, and the history of the tropics is strewn with the tombstones of once prosperous industries. But for the energy, enterprise, foresight and indomitable pluck of those engaged in tropical agriculture these failures might have been even more frequent than they are, but it is to be hoped that, with greater attention to economic tendencies, prompt measures may be instituted to eliminate, as far as possible, the possibility of such disasters. No policy of "scuttle" is suggested but the need is urged for practical recognition of the necessity of broadening the economic basis of those tropical areas whose fortunes are founded upon the vagaries of one fickle crop.

SUGAR-CANE EXPERIMENTS.

PROFESSOR J. SYDNEY DASH, B.S.A.

I. Cultivation Methods.

IN October, 1923, the Department of Agronomy, desirous of demonstrating, especially to students, various methods of preparing land for sugar-cane, and not having at that time a sufficient area under cultivation at the College, was able through the kindness of the Trinidad Department of Agriculture to carry out the object in view on two and a half acres at the St. Augustine Experiment Station. The scheme was planned by the writer, the work being actually carried out under the supervision of Mr. L. A. Brunton, Assistant Superintendent of the Station, to whom much credit and thanks are due for the care taken of the plots, which being approximately half an acre each in size, are sufficiently large to warrant presentation of the results comparatively.

The soil of the field may be described as a light to medium silty loam, easily adapted to tillage by light animal-drawn implements. It is divided by drains into beds 22 ft. wide and each plot occupied two beds, two varieties being used —B. H. 10 (12) and Ba. 6032—one in each bed. The plots, five in number, therefore, occupied ten beds altogether, so that we have a combined test of methods and of these two well-known varieties. The field which had been under cotton during the previous twelve months, was first ploughed and harrowed in the usual way, all rubbish and weeds being covered. Tables I and II give methods of treatment and results respectively.

Table I.—Treatment.

Plot.

1. Drilled, cuttings planted 7 ft. between the rows and 2 ft. in the rows. Pen manure at the rate of 15 tons per acre applied in the drills after canes had made sufficient growth, banks broken at the same time.

2. Drilled, pen manure at the rate of 15 tons per acre applied in the drills at the time of planting, cuttings inserted through the manure and banks broken. Planting distance 5 ft. by 5 ft.

3. Drilled, sweet potatoes planted on the banks as a catch crop. Cuttings planted 5 ft. by 5 ft. Pen manure applied in the drills at the rate of 15 tons per acre as soon as sweet potatoes were dug, banks broken at the same time.

4. Cane holes dug about 2 ft. square and 6 in. deep. Planting distance 5 ft. by 5 ft. Pen manure at the rate of 15 tons per acre buried in holes between stools.

5. Flat planting—no drills or holes made. Well rotted pen manure at the rate of 10 tons per acre stirred in before planting; distance 5 ft. by 5 ft., lines being marked out by small pony plough.

The drills (furrows) were all made with a double mould-board plough. The plots were planted during the week of November 8 to 15, 1923. Cultivation and weeding after planting were the same for each plot. The reaping was carried out from February 25 to March 3, 1925. As regards costs of preparation, those of plot 4 where hand labour had to be used for digging cane and manure holes, were 23 per cent. higher than for the others which were practically the same. In plot 5, the cost of stirring in the manure and lining was approximately equivalent to the cost of making drills. In plot 1, there were fewer drills but many more cuttings were planted which about evened up the costs. The rainfall for the sixteen months during which the canes occupied the land was 88 inches.

Table II.—Results.

Plot No.	*Variety.*	*Yield per acre, tons.*	*Average tons.*
1.—	Ba. 6032 B.H. 10 (12)	55·45 48·19	51·82
2.—	Ba. 6032 B.H. 10 (12)	57·86 58·00	57·93
3.—	Ba. 6032 B.H. 10 (12)	43·30 37·40	40·35
4.—	Ba. 6032 B.H. 10 (12)	49·25 50·40	49·83
5.—	Ba. 6032 B.H. 10 (12)	47·40 45·70	46·55

It will be observed that plot 2 in which the pen manure was applied in the drills at the time of planting and cuttings inserted through the manure gave the highest returns, being 6·11 tons per acre more than plot 1, the next best, which was the only plot with a different planting distance—7 ft. by 2 ft. as against 5 ft. by 5 ft. Plot 4—cane hole system—occupies third place, followed by plot 5—flat planting, last place being taken by plot 3. By referring to Table I, it will be seen that this last had sweet potatoes planted on the banks as a catch crop. As a consequence, the canes were manured late and suffered a setback at the start. Moreover, the actual value of the potatoes reaped (after deducting cost of planting and digging), along with any possible advantage accruing as a weed control crop, was far from being enough to compensate for the value of the extra cane reaped —nearly 18 tons per acre more—from plot 2. It may not be possible to entirely adopt this method on an estate for various reasons, an obvious one being that all the manure necessary is not likely to be available at the time of planting; again, very light, trashy material could hardly be handled to the best advantage in this way, as the young cane roots would not find in such a medium the best conditions for development. Nevertheless, it is a quick, easy, and economical method,

especially during seasonable weather, when the cuttings may simply be dropped on the top of the manure in the drill and covered with soil from the adjacent banks.

These results in general tend to emphasize the value of applying pen manure early. In connection with distance of planting—of secondary consideration in this series—results would seem to indicate that wide spacing of rows and close spacing in the row, under the conditions of these experiments, offer no advantage from the standpoint of yields over spacing distance 5 ft. by 5 ft. Considering plot 1, by itself, however, there is evidence that Ba. 6032 is better adapted to planting 7 ft. by 2 ft. than is B. H. 10 (12). Obviously, there is room for a series of experiments on this question of spacing, with a view also of determining effect on the quality of the juice. They should be on a sufficiently large scale to enable accurate costs to be kept. In the experiments under review, the yield, over the whole area for the two varieties, shows very little difference between them, Ba. 6032 giving 50·65 tons per acre and B. H. 10 (12) 47·93 tons per acre. Unfortunately, it was not possible to get any factory returns, as this material was the first to go through the College factory mill and much of it was utilized during the period of trying and adjusting machinery. From our knowledge of the juice character of both varieties, B. H. 10 (12) would be given first place in this case on sugar yield per acre, the tonnage difference in the field not being enough to place it below Ba. 6032, a variety with poorer juice usually.

(*To be continued.*)

THE CULTIVATION OF CASTOR SEED.

Messrs. Mirrlees Watson & Co., Ltd., Glasgow, have recently issued an instructive little pamphlet (No. S.600) on "Castor Seed." The Kenya Colony Agricultural Department is responsible for much of the information which describes the extending use to which castor oil is being put. The Castor seed cake and meal constitute excellent manures. A good description is given of different methods of expressing the oil, the method employed, depending, of course, on the use to which the oil is to be put. Vegetable oils have undergone considerable development within recent years and it is interesting to note that this British firm is giving considerable attention to a subject of growing importance to the Empire.

The Editor begs to thank readers who have returned spare copies of Vol. I, Nos. 1, 7 and 9 of *Tropical Agriculture.* Additional supplies of Vol. I, No. 9 are still urgently required and the Editor will also be pleased to receive spare copies of Vol. II Nos. 1, 2 and 3, supplies of which are already exhausted.

COTTON NOTES.

THE Third Annual Bulletin of the Department of Agriculture of Nigeria contains three papers on cotton, which undoubtedly contain the best work on cotton so far performed on the African Continent, with the possible exception of Egypt. It is to be hoped that this work may be the precursor of researches on similar lines in other parts of Africa.

The most important of the three papers consists of a survey of factors inhibiting the development of the cotton plant in Southern Nigeria, and summarises observations made by Dr. T. G. Mason and Mr. G. H. Jones. It is a somewhat remarkable circumstance that in spite of a considerable indigenous cotton industry in Southern Nigeria the records of attempts to introduce American upland cotton into this district have met with little success. Not only have the yields of American cotton been usually unsatisfactory but that of the native variety has been little better when grown adjacent to it. The native cotton, however, is apparently grown successfully on the farms in the surrounding country. The authors establish the fact that out of every hundred flowers formed in American cotton sixty-six are lost through shedding. Shedding is due to four main causes, bollworms, cotton stainers, external boll disease, and physiological shedding. Forty-one per cent. of the bolls were attacked by the bollworm, seventeen per cent. were destroyed by cotton stainers, twelve per cent. were attacked by external boll disease, while only eleven per cent. were without any lesions. The actual yield of seed cotton, had no boll shedding occurred, would have been at the rate of 1,300 lb. per acre. Examination of open bolls showed that thirty-five per cent. were affected by internal boll disease, and a further twenty-eight per cent. possessed stained lint. Thirty-two per cent. only were without any lesions. The final yield of seed cotton per acre was only 148 lb.

We have here the explanation in plain black and white figures of the failure of American cotton in Southern Nigeria. It is due to a combination of bollworm, cotton stainer, and the well-known bacterial disease due to Pseudomonas malvacearum. This combination is apparently even worse than the combination of the last two which threatened to put an end to the Sea Island cotton industry in St. Vincent in 1914-16. It is now clear beyond measure that there are three major insect pests of cotton, the boll weevil, the pink bollworm, and the cotton stainer, Dysdercus spp. In the opinion of the writer the last may ultimately prove the worst of the three. When it is remembered that the cotton stainer produces a new generation every six weeks or so, and that a single puncture of a boll usually causes partial or complete destruction of that particular lock through inoculation with the fungi of internal boll disease, it is certain

that cotton growing anywhere in tropical Africa is up against one of the toughest problems of biological science. In the West Indies we have now been familiar with the cotton stainer and internal boll disease for the last ten years, and we have such a wholesome respect for the combination that the first question which occurs to our minds about any new cotton-growing country is :—What is the status of the cotton stainer? Mason and Jones have answered that question for Southern Nigeria, but little is known about other parts of tropical Africa. The internal boll disease is now known to be present over most of East Africa and also from Queensland. From the facts so far presented it seems legitimate to conclude that cotton growing in tropical Africa will probably have to face the internal boll disease as a factor which may prevent the cultivation of cotton over much of the equatorial region.

S. C. HARLAND.

HONEY IN PALESTINE.

DURING 1923 some 4,000 kilos. of honey were exported from Palestine to England, this product being third in the list of values. The Director of Agriculture and Forests, Palestine, estimates the honey crop for the present year at 60,000 kilos. from about 4,000 modern hives, an average of 50 kilos. per unit. Returns from primitive native hives, however, have been very poor, no surplus having been obtained in several districts. Nearly the whole crop has been sold through the Beekeepers' Association, and a ready demand has been encountered. It is further estimated that about 10,000 kilos. will be shipped to England, 8,000 to Egypt, and 2,500 to the United States. The Beekeepers' Association have been discussing the possibility of official certification of purity and origin for exported honey, together with the question of an attractive and pictorial label for all containers.—(*Chamber of Commerce Journal.*)

NIGERIA.

As we go to press we learn that C. J. Lewin, Esq., Superintendent of the Department of Agriculture, Nigeria, has kindly consented to act as honorary correspondent for *Tropical Agriculture.* A report on the cotton industry of Virginia will be published in our next issue and will be followed later by a report on cocoa.

THE Editor regrets that through an error in the office several circulars, purporting to remind readers that their subscriptions were due, were sent out to new readers. The Editor trust that these readers will consider the circular as not having been received.

ENTOMOLOGICAL NOTES.

Further Notes on Insecticides and Insect Control Methods.

By C. L. WITHYCOMBE, PH. D., D.I.C.

IN *Tropical Agriculture,* Vol. I, No. 8, 1924, a few recently developed insecticides were mentioned and briefly discussed. The present notes are in the nature of a continuation of this previous article.

In the past few years a great deal of attention has been directed towards the preparation of insecticides in the form of dusts, and the method of dusting poisons upon the foliage of plants instead of spraying a watery mixture has, under indicated conditions, to a certain extent replaced the latter method. Dusting, in its simplest form, consists of the distribution of poison over the foliage in the form of a fine powder by means of a suitable bellows or dust-blower. The advantages of this method over wet spraying, where possible, are obvious, in the saving of time and money alone. Again, the difficulty of obtaining water in some parts militates considerably against spraying, and it must be remembered that even where a plentiful supply of water is available this may not be suitable for the mixing of spray liquids. Very deleterious effects may be produced by diluting sprays with certain hard and alkaline waters, as has been pointed out by de Ong. Softening such waters is not always easy, nor does this treatment always rectify matters completely. Nevertheless wet spraying still maintains a prominent position among our methods of dealing with insect pests and there are many strong points to be advanced in its favour.

With wet spraying many experiments have been carried out in the matter of preparing "spreaders" and "stickers" for increasing the evenness with which the spraying materials coat the leaves of the plants under treatment and to prevent the formation of drops. Among such substances may be mentioned soap, saponin, oils, glue, gum, flour, and "calcium caseinate," the last having received particular attention. R. H. Robinson has recently advised the use of skim milk and skim milk powder, with lime, for the same purpose, as being much cheaper than "calcium caseinate" and equally effective.

To the well-known group of insect poisons collectively designated "arsenicals" one of the best innovations of late years is magnesium arsenate. The majority of commonly used arsenic compounds are open to the serious objection that they are often injurious to the foliage of certain plants upon which they are sprayed or dusted, and this drawback may debar their use upon occasions otherwise indicating the employment of arsenicals. The difficulty has been to a certain extent obviated by mixing the arsenical with some other substance to reduce the "burning" effect. Thus calcium arsenate is found to be improved by the addition of lime.

Howard (1924) found that magnesium arsenate was by far the best arsenical for use against the Mexican bean beetle in the South-eastern States of America. In the West lead arsenate and zinc arsenite had been recommended but these substances were found to be much too injurious to foliage in the East and had therefore to be abandoned. Calcium arsenate could only be employed when of high grade and diluted with lime. Magnesium arsenate, on the other hand, was entirely satisfactory and gave consistently good results. It was highly efficient in destroying the beetles and at the same time it did not "scorch" the foliage of the beans.

* * * * * *

Of the non-arsenical, inorganic, stomach poisons sodium fluoride still occupies a prominent place. This substance is well known on account of its efficacy against cockroaches and other domestic pests, but it has also been successfully applied as a general insecticide. It possesses the great advantage of being comparatively innocuous to domestic animals and it can therefore be used as a dip against lice on poultry, in poison baits, &c., where animals are likely to come into contact with the insecticide. Somewhat similar remarks might be made of borax or sodium borate.

Sodium fluosilicate is another useful insecticide of a somewhat similar nature and which is often stated to be more effective than sodium fluoride. S. Marcovitch considers it to behave as both a contact and a stomach poison. In the Journal of Economic Entomology for 1925 he writes that, as compared with arsenicals, it is cheaper (less than half the price of calcium arsenate), it acts more rapidly, is less dangerous to man, and has a wider range of applications. He suggests that it should prove effective against the notorious cotton boll weevil.

All of the above non-arsenical insecticides can be safely recommended for general use. They appear to be specially suited to domestic purposes but their wider applications are also important.

Moore and Campbell (1924) have tested a number of non-arsenical stomach poisons and find cuprous cyanide very efficient. Barium oxalate and barium fluoride are reported by them as being also good.

"Cube," a Peruvian plant used as a fish poison, is mentioned together with pyrethrum and derris as a promising insecticide by McIndoo and Sievers (1924).

* * * * * *

In the improvement of nicotine sprays notable contributions have been the work of Moore (1918) and Hoyt (1924) on the preparation of true nicotine soaps. Ordinary soaps are of course formed by the combination of alkali bases, such as soda and potash, with fatty acids. The general practice in making up nicotine sprays has in the past been to mix nicotine or a nicotine salt with an ordinary soap. It has been shown, however, by the above workers that nicotine itself usually behaves as a strong diacid base and combines with fatty acids to form soaps, just as do soda and potash respectively. Hoyt compared soaps made by a combination of nicotine with the fatty acid of castor oil and also with that of coconut oil. Both soaps, at a strength of ·05 per cent. with water, were found to have marked insecticidal properties against aphids, but the soap made with the fatty acid of coconut oil was distinctly superior.

Siegler and Popenoe have been investigating the insecticidal properties of the fatty acids themselves and have discovered the most important fact that these are often highly toxic to insects. It seems to have been tacitly assumed in the past that soaps owed their toxicity largely to their alkali ingredients and that the fatty acids had little deleterious effect upon insects. Siegler's and Popenoe's work shows that while the lower homologues of the fatty acid series are not markedly toxic several of the higher homologues are distinctly so. Thus caprylic acid killed 90 per cent. of aphids sprayed when used at a dilution of one part in five hundred, and with a proportion of the one in a thousand parts of water the kill was only slightly decreased. Capric acid destroyed more than 99 per cent. of the aphids sprayed with it when used at a dilution of one part in one thousand two hundred of water. Good results were also obtained with lauric and myristic acids.

(The fatty acids above mentioned were used either in the free state or combined as soaps with potassium, sodium or ammonium.)

In looking for a suitable commercial product containing these desirable fatty acids a mixture known as "double distilled coconut fatty acids" was selected as embodying most desirable features. Of this, when made into an emulsion with water the writers say: "The spreading power of the emulsion is excellent, toxicity high, and cost of materials extremely low. Prepared by this formula coconut fatty acids have compared favourably in efficiency, pound for pound, in the experiments so far conducted, with commercial nicotine preparations at less than one-fourth the cost per gallon of spray mixture."

It is quite possible that the nicotine coconut oil soap of Hoyt may owe some of its superior qualities to the constituent fatty acids of the coconut oil.

* * * * * *

Fumigation with carbon bisulphide has always been open to the serious objection that the heavy vapour of this liquid is highly inflammable and explosive when mixed with air. Roark, Back, Cotton and others have lately experimented with a large number of compounds and mixtures in an endeavour to find a satisfactory substitute. They now claim that a mixture of ethyl acetate and carbon tetrachloride is quite effective against

the usual insects infesting stored foods; it is non-inflammable, leaves no odour or taste in the fumigated materials (including bread), is not poisonous to man and can be obtained at a reasonable price. Its great advantage of course lies in the fact that it can be employed under conditions where danger of fire or explosion would preclude the use of carbon bisulphide.

Dingler, advocates hexachlorethane ($C_2 Cl_6$) as an effective solid fumigant against clothes moths. Two or three pounds of this substance are required per cubic yard of storage space. The adult moths are stated to be thus killed in twenty-four hours, eggs in four days, and larvae, which cease feeding in two days, die in from ten to twelve days. No damage is done to fabric either in light or darkness.

* * * * * *

In connection with anti-mosquito measures Holden (1924) has endorsed the value of cresol as a larvicide. This was recommended by Mayne in 1920, its great advantages being, firstly, that treatment of stagnant water with it does not deter female mosquitoes from continuing to lay therein, and larvae emerging from eggs so deposited are of course killed by the cresol, while oiling repels mosquitoes and drives them to seek suitable water elsewhere. Secondly, a further point in favour of cresol is that algae and reeds need only be cleared where they are very dense, while an oil film is hindered in spreading by reeds. Water treated with cresol, at the rate of one ounce to every hundred cubic feet of water, was found to remain free of larvae for fourteen days in Macedonia, but in the campaign under discussion treatment was renewed once a week for safety.

In Louisiana, aeroplanes distributing Paris green have been used over swampy land to control malarial mosquitoes.

Finally, among the more spectacular of recent methods may be mentioned the application of X-rays and of highly sensitive microphones for the detection of insects in timber and stored goods. Thus Yaghi has used a Röntgen tube successfully to detect insects boring in trees, stored grains, wool, &c.

C. K. Brain has made some preliminary experiments with microphones such as are used in wireless transmission. He finds that it is possible to amplify the sounds made by insects to such an extent that the gnawing of borers in apples and the movements of weevils in grain and yeast cakes are distinctly audible. He suggests that fruit and seeds for export might well be so tested for included pests before shipment.

The number of subscriptions received during March has established a new record, considerably exceeding those obtained during January. The total number of subscribers is now nearly three times as great as on January 1st, 1925.

MYCOLOGICAL NOTES.

The Sweating of Cacao.

THE purpose of this treatment is to separate the saccharine sap from the cells of the pulp tissue which invests the close-textured underlying portion of the seed-coat enabling the liquor to drain away and facilitate the subsequent drying of the bean. The simplest method is to put the wet cacao in a heap, cover with banana leaves allow it to drain for a day or two and then spread it out to dry in the sun; this treatment is often extended by piling the warm cacao into covered heaps at night for two or more days after draining. A plantation method first used in the West Indies and the Guianas and now widely employed is to sweat the wet cacao covered with banana leaves in a series of wood boxes having perforated bottoms the mass being turned over into a fresh box preferably each day. The liquor from the pulp drains away within forty-eight hours, and the process is ended after three days or may be continued for six days or more, the number of boxes provided depending on the length of the period. Criollo and the finer criollo-forastero hybrids are subjected to a short sweat not exceeding three days while the amelonado, calabacillo kinds are given a long sweat of six days or more. In Ecuador, however, the "cacao nacional," which forms the bulk of the crop and resembles an amelonado, is merely drained for a day before drying. Where cacao is grown on a plantation scale prolonging the sweat beyond the period (one or two days) required for mere drainage, shortens the sun-drying period by several days and effects a profitable economy in drying space and labour. The changes, undergone by wet cacao during the sweat have attracted attention and in 1913 a collection of essays by professional and other investigators was published in book form by "Tropical Life" entitled "The Fermentation of Cacao." These essays embodying original research together with other published work abstracted by the editor (H. Hamel-Smith) seemed to cover the ground rather completely, but recalling the old adage that the more finished an enquiry appears the more in need is it of further examination one cannot doubt that a re-investigation of the sweating process would result in modified views. The two most obvious changes are the draining away of the pulp-sap and the heating of the mass. The juice expressed from wet cacao taken from the mature freshly picked pod contains (Nicholls) about 85 per cent. water, 10 per cent. glucose under 1 per cent. cane-sugar a little organic nitrogen, pectin and alkaline salts and about 0·3 per cent. of a non-volatile acid (tartaric acid according to Bainbridge and Davies); neither alcohol nor acetic acid are present. Bainbridge and Davies found in the drippings 15 hours after sweating was begun 3·5 per cent. of glucose, 4·9 per cent. of alcohol and nearly 0·6 per cent. acetic acid in a total acidity of 0·8 per cent. Alcoholic and acetic fermentations due to yeasts and bacteria were

already in progress in the first sweat box. All investigators agree that the juice squeezed out of the pulp tissue by the pressure of the mass of wet cacao, and held up by it undergoes normally an alcoholic fermentation caused by yeasts introduced from the surface of the pods in breaking and left on the sides of the box from a preceding charge. As the liquor drains away, which is hastened by turning the cacao into the second box, after a day, air is drawn into the mass and acetic bacteria oxidize the alcohol to acetic acid. Draining is normally at an end during the second day so that yeast action ceases but the acetic bacteria continue to work in the shrunken pulp tissues on the surface of the beans.

Bainbridge and Davies have divided this so-called "external fermentation" into four stages :—

1. Characterised by an abundant growth of apiculate yeast—a small, rather weakly fermenting form, unable to invert and ferment cane-sugar which multiplies on ripe fruits and survives in the soil.

2. A rapid development towards the end of the first day of more actively fermenting true yeasts (called "true" because they can form spores) which crowd out the apiculate yeast. Their activity is believed to promote drainage so that the drippings come away more freely.

3. A rapid development of acetic bacteria causing the later drippings to be a weak vinegar. The vinegar fly (Drosophila sp.) is stated to inoculate the cacao with these bacteria. The acetic bacteria continue active until sweating is completed (six days or more).

4. After eight days the bacterial flora changes and sporing forms of the B. Subtilis group are abundant.

Finally during the early days of drying, the beans become spotted with white colonies of yeasts and bacteria.

The writer can confirm the sequence as probably normal for a six days box sweating in Trinidad. Sometimes, however, the true yeasts do not appear and the apiculate yeast is the only form present, associated with viscous ropy drippings due to a bacterium. He has isolated three kinds of acetic bacteria resembling species active in the "quick vinegar" process of Europe.

Hudson's essay includes some daily temperature records of six-day box fermentations with 2,000 pounds of wet cacao. The temperature of the mass at the start was not recorded but was probably about 80° F.

Four of these records which were regarded as normal are reproduced.

	After *1 day*	*2 days*	*3 days*	*4 days*	*5 days*	*6 days*
1.	85	96	110	117	114	110
2.	84	95	110	112	115	114
3.	87	10	115	116	117	114
4.	88	106	116	119	116	116

The wet cacao was turned into a fresh box each day. These figures indicate a general rise of temperature during the first two days when yeast fermentation was presumably active and a rapid rise on the third and fourth days when acetic fermentation would be active, followed by a gradual fall. The question arises as to whether the high temperatures of the third and fourth days can be accounted for by the external fermentation alone. In the quick vinegar process as practised in England, the temperature is maintained between 105° and 110° by controlling the air supply. If aeration is excessive the temperature rises rapidly and the acetic acid content of the liquor falls due to oxidation of the acid by the bacteria to carbonic acid and water. It is probable that after drainage has ceased, and the pulp has contracted to a thin layer the aeration is sufficient at a temperature already exceeding 105 to promote complete oxidation and cause a further considerable rise of temperature. If so, the acidity of the pulp layer will begin to fall about the fourth day and permit of the gradual development of a new microbial flora towards the end of the sweating period. The presence of sporing bacilli and the development of moulds and colonies of fruit-ether yeast (Willia anomala) if sweating is continued until the temperature falls to near 100 and the rapid appearance of such colonies when drying has begun, indicate such a fall in acidity. The later changes, in the external layer are, however, in need of further investigation. During sweating the pulp layer becomes to a large extent detached from the underlying portion of the seed-coat ; a long sweat is, evidently, not necessary to effect this, as in Java and Ceylon where the cacao is washed a short period of three and a half days or less has been found sufficient even with forastero kinds. This separation of the pulp is also necessary in Trinidad and other places where the partially dried cacao is "danced" as it enables the slime to be spread uniformly over the surface of the bean and to be left in part adhering to the drying floor from which it can be scraped away.

According to Loew a similar loosening of the slime layer from the parchment of pulped coffee occurs during a short fermentation of less than one day after which the slime can be readily washed away. The cause of this separation is not known. Reference must now be made to the changes in the embryo which sweating brings about. Some of the essayists pointed out that the germinating power of the bean is lost by exposure for a few hours, to a temperature approaching 110. Oxidizing, and reducing enzymes were shown also to be present in the tissues of the embryo. They were of opinion, therefore, that the rise of temperature during the first two or three days due to the external fermentation killed the embryo and put the enzymes into contact with substances on which they could act; the resulting "internal" fermentation was held responsible for the marked rise of temperature on the third and fourth days

and the activity of the oxidizing enzymes (oxidases and peroxidases) was stressed. No proof was furnished that air has access to the embryo during sweating.

The space within the moist impermeable seed-coat is filled by the cotyledons and any contraction following the gradual death of the tissues of the embryo results in an escape of cell sap so that the interior of the bean is filled by the embryo and its juices. Harrison's analyses show, in fact, that the living embryo contains from 35 to 40 per cent. of water. As both oxidizing and reducing enzymes are present in the embryo access of air during sweating is not a necessary condition for enzyme activity. Nothing, however, is definitely known as to the nature of the substances on which the enzymes are presumed to act during sweating nor of the products resulting from such action. Some investigators have claimed the presence of an oxidisable complex glucoside (cacaonin) in the living embryo which yields cacao red, dutrose and theobromin by enzyme action while others claim the presence of an oxidisable tannin; the presence of both these bodies has been denied by other biochemists. During drying as moisture escapes through the seed-coat and the tissues of the cotyledons contract air enters and oxidations doubtless occur resulting in the more or less uniform light or dark brown break of the cured bean; it is also probable that the essential oil of cacao (demonstrated first by Sack and then, carefully investigated by Bainbridge and Davies), to which the cured bean owes it aroma is an oxidation product of a pre-existing terpene. It has been pointed out that there is no evidence of such changes taking place during sweating so that provisionally the rise of temperature must be attributed wholly to the external fermentation about which some definite things are known. Knapp and Wadsworth have recently shown that the seed-coats of the coarser kinds of cured cacao which have undergone a long sweat contain appreciably more theobromin than the seed-coats of similar cured cacao which had not been sweated and the nibs correspondingly less theobromin. This observation may explain the reduced bitterness of long sweated cacao of the coarser kinds, the juice exuding from the killed cotyledons having a longer period to soak into the seed-coat. The main advantage of giving cacao of the amelonado and calabacillo type a long sweat is to be attributed, most probably to the opportunity for a more thorough disintegration of the investing pulp layer and a softening modification of the underlying seed-coat which facilitates the escape of moisture and the entrance of air during drying. The cotyledons of such coarse kinds do not soon separate during drying and any treatment which promotes the entrance of air in drying favours the production of a more uniform brown break in the cured bean. This advantage of a long sweat for such cacao is likely to be most pronounced when artificial drying is used owing to the much reduced drying period and would appear to be especially desirable when the cacao is to be cured in a few hours in a vacuum dryer.

Hudson writing as a practical planter, stressed the point that the main reason for sweating cacao produced on a plantation scale was to facilitate drying and economise on drying space and labour. The economy effected covers the cost of dancing and polishing or of washing where that is practised and brings a slightly higher market price for the better looking "fine estates grade" than for the imperfectly sweated (merely drained) cacao of the same type of the small grower. The manufacturer (adapting himself to the consumer's needs) dictates the market price which depends on the inherent characters of the nibs. Experience has shown that no methods of sweating and drying can appreciably affect these inherent characters due, partly to the kind of cacao grown and in part to soil and climate so that the main advantages derived from sweating and those from artificial drying begin and end on the plantation.

S. F. A.

References.

The Fermentation of Cacao .. "Tropical Life," 1913

The Essential Oil of Cacao .. J. S. Bainbridge and S. H. Davies Journ. Chem. Soc. 101 P. 2209

Vinegar .. C. A. Mitchell, 1916 (Griffin & Co.)

Distribution of theobromine, &c. .. A. W. Knapp and R. V. Wadsworth Journ. Chem. Ind. 53, p. 124 T.

SUGAR MACHINERY.

We have recently received Pamphlets Nos. S. 60 and S.350 from the Mirrlees Watson Company, Glasgow. Pamphlet No. S. 60 gives an interesting illustrated description of the "Meinecke" Patent Intermediate Carriers between Cane Mills which eliminates the use of chains, sprockets, friction-clutch, shafts, slats or other moving parts which are always subject to derangement or to breakage.

Pamphlet No. S. 350 gives a description of a new method for the correct regulation of a Multiple Effect Evaporator which enables the maximum duty to be obtained from it.

Pamphlet S. 800 gives a comprehensive illustrated list of parts for Sugar factory machinery. The system of code words enables factory managers to obtain spare parts with minimum delay.

The Editor will be pleased to send a gratuitous specimen copy of *Tropical Agriculture* to any one interested in tropical development.

GOVERNMENT BOTANIC GARDENS.

By Lieut.-Colonel Sir David Prain, C.M.G., C.I.E., LL.D., F.L.S., F.R.S., late Director of Royal Botanic Gardens, Kew and Vice-Chairman of the Governing Body of the College.

[*The following is the conclusion of the Sir George Birdwood Memorial Lecture delivered before the Royal Society of Arts (Indian Section) by Sir David Prain. The first and second parts appeared in the issues for March and April.*]

After a period of quiescence came the wave of "scientific" enthusiasm, which saw the formation of a botanic garden in Java in 1817, the conversion of a "pleasure garden" at Saharanpur, which owed its existence to the munificence of an Indian noble of means and taste, into a botanic garden for Northern India, and the transfer in 1821 to a more suitable locality of the garden in Ceylon which had been revived in 1810. In 1822 Dr. Nathaniel Wallich, Buchanan's successor at Calcutta, visited the Malay Peninsula as the guest of Sir Stamford Raffles, and was able to secure the restoration of the Penang Botanic Garden. In 1823 Raffles formed a new botanic garden at Singapore. Again, however, official enthusiasm was short-lived; the second Penang garden was abolished in 1826; the garden formed by Raffles at Singapore was abandoned in 1829. After another and longer period of neglect came another wave of enthusiasm; a second botanic garden was formed at Singapore in 1878 and a third botanic garden at Penang in 1884. The latter only survived until 1910, and if the lessons of history justify an "intelligent anticipation of events," we need hardly doubt that one day some reason may be manufactured for the abolition of the garden which at present replaces the one whose formation was due to the foresight and judgment of Sir Stamford Raffles. The experience of India proper has hardly differed from that of Malaya. Efforts made by the Presidency with which Sir George Birdwood was most intimately associated were not more successful than those of Madras: largely owing to him, Bombay can boast an Oriental "paradise," but hardly a botanic garden. Even in Upper India, for which the Saharanpur Garden served as a useful scientific centre during three-quarters of a century, the attempt to maintain a Botanic Garden has been abandoned. There is now only one Indian Government Botanic Garden.

This record is perhaps disappointing, but it need hardly be regarded as surprising. A botanic garden, to be of use, involves considerable recurrent expenditure. If its work is to be of value, the Government that maintains it must discourage attempts to produce direct revenue: energy expended in this direction involves corresponding impairment of scientific efficiency. If a province cannot afford a botanic garden which brings no revenue, it is sounder economy to do without one: the return which a botanic garden brings is indirect. How vast that return may be South-eastern Asia knows. By what they have done in connection with the creation of such industries as those connected with tea, cinchona and rubber all the outlay by their respective Governments in respect of the botanic gardens of Calcutta, Buitenzorg, Peradeniya and Singapore has been repaid a hundredfold.

If the facts suggest that there has been a tendency at times to abolish a botanic garden whenever this was possible, this policy has rarely been the direct result of official antagonism towards institutions that are included in the group quaintly classed by secretaries for finance as "Scientific and other Minor Departments." More often the action has been an indirect result of the attitude towards the work of a botanic garden adopted at various times by botanical thought as a whole. That attitude has not always been the same; that it should often have been a critical one need hardly create astonishment. It has been, and must remain the duty of a botanic garden to increase the sum of natural knowledge; to place the natural knowledge it may possess at the disposal of industry and commerce; to do what it can to apply this natural knowledge in practice. Among the steps taken by the Calcutta Botanic Garden, for example, to add to natural knowledge may be mentioned those of systematic and economic survey, both commenced during the incumbency of Roxburgh, and the former, at least, prosecuted with vigour ever since. Systematic survey work began in the Spice Islands in 1796; economic survey work began when Roxburgh's suggestion that Buchanan be sent on deputation to Chittagong was carried into effect in 1798. In survey work reliance must be placed on the method of observation. The obligation of botanic gardens to depend on this method in some of their work has been the subject of unfavourable criticism by those so fortunately situated as to be able to employ the method of experiment in all they undertake. In placing the natural knowledge they possess at the disposal of others, it is the duty of botanic gardens to arrange for floristic and monographic study, a proceeding which ensures for them the disapproval of those who regard "system" as unscientific and the preparation of hand-lists and gazetteers as mechanical. More antiquated even than the continued reliance on observation and the continued employment of system, seemed to the academic eye of half a century ago, that continued belief of botanic gardens in the validity of the XVIIth century injunction that the application of natural knowledge is as deserving of attention as its advancement. To this determination of botanic gardens to abide by what was good in the old while absorbing what was best in the new, India owes her tea-gardens, Java her cinchona plantations, Ceylon and the Malay Peninsula their rubber industry. But the English and the Dutch Indies owe to this attitude on the part of their botanic gardens another and perhaps a greater debt. What has been gained

as the result of these successful ventures can be computed. What has been saved to industry and commerce by the avoidance of enterprises that botanic gardens could show were doomed to failure, is almost incalculable.

It is fair to remark that one of the " scientific " objections to botanic gardens is that for work of this kind such institutions are needlessly expensive instruments ; that equally good results may be anticipated if the work of exchange and cultural experiment be entrusted to cultivators who are not botanists. Natural affection, we have seen, induced a " botanist " so renowned as Roxburgh to express this very view. The technical portion of the task no doubt can be so provided for. But, if exchanges of plants are to be of permanent value, there must be an assurance that the plants transmitted are precisely identified. This can only be assured when the plants imported by a distributing centre where there is no " botanist," have come from a botanic garden ; or where those despatched from such a centre are received by a botanic garden. It is also fair to admit that in certain European scientific circles it has at times been urged that the day of botanic garden exchanges of useful plants is over, and that now the work of the plant-breeder should replace that of the field-observer. But this is not claimed by the student of genetics, whose work is nowhere more highly valued than in a botanic garden. Nor is it claimed by those interested in plant-breeding and plant-importation in America, where the affection for XIXth century habits of thought, still characteristic of Europe, has died out.

The records of the garden founded by the Government of Madras at Marmalon illustrate the conditions under which the " phytologist " who is not a " botanist " has to work. In 1786, the year in which the Calcutta Botanic Garden was founded, Dr. James Anderson happened to observe on a " Nopal " plant some cochineal insects. He did not know, and we may never learn, whether the insect he noticed was that which supplied the *grana silvestris* of commerce ; it was clear to him that it was not the true cochineal which supplied the *grana fina* then in demand in the trade. Nor did Anderson know whether the " Nopal " on which he observed the insect was that on which the true cochineal could be raised. Anderson reported his observation to his Government, and through them recommended that steps be taken by the Court of Directors to introduce the true insect to India. The Court sought the help of the War Office and the President of the Royal Society : plants of the *Cactus Cocci* as the *Opuntia* required was then termed, were transmitted to Madras from Kew. Writing on February 19th, 1790, to the Governor of St. Helena, Anderson said : " Having recommended that the Honourable Court of Directors shall first introduce the genuine cochineal at St. Helena, from whence it may easily and certainly be forwarded here, I send you another box of Nopals by this opportunity of the ship Pigot." Again, on September 15th, 1790, Anderson wrote to the Governor : "Understanding that Sir George Yonge, Secretary of War, is establishing cochineal insects at Antigua with a view to transporting them to this country, in consequence of my publications on that subject, I have forwarded a dozen more Nopal plants that you may have abundance in readiness for their reception." A letter of September 14th, 1790, asking Government authority to place these plants " on board the Houghton under the care of Capt. Munro," tells us that the plants were "twelve Kew Nopals." In that letter Anderson adds : "You may acquaint the Honourable the Directors, from my own inspection of the garden there [Marmalon], that it contains fifteen hundred very thriving plants of the Kew Nopal, many of them in flower, which might, if necessary, be immediately multiplied into as many thousands." The plants reached St. Helena safely ; another letter to the Governor of St. Helena, dated February 15th, 1791, says : " I am favoured by this Government with your acknowledgement of the receipt of Nopal plants, which I have forwarded on different ships, and am happy to learn they are in so thriving a condition to supply an article of vegetable food for the inhabitants of St. Helena, for Covent Garden is not better supplied with asparagus than the markets of the kingdom of Mexico are supplied with the tender tops of Nopals which are every day brought to table."

One consequence of Anderson's publications regarding cochineal was that Bengal became as interested in this adventure as Madras. The first volume of the Calcutta Gazetteer, interesting to-day mainly for its news letters from the seat of war in Mysore, and for its local advertisements, contains among the latter an intimation that a " Nepaulry " was for sale. It did not find a ready purchaser, for the notice had to be repeated with an assurance that the plants were ready to receive the insect. The speaker, in his early days in India, did not know what a " Nepaulry " was, and, so completely had the term disappeared, could obtain no information from more experienced friends. He wrote therefore to Sir George Birdwood, and, needless to say, had his difficulty cleared up by the return mail.

At what date the insect reached Madras from St. Helena, the records do not say. Anderson, though grateful for the sympathetic help given him, was then preoccupied with other duties, for he added, in writing to the Governor of St. Helena, who was also President of the Planters' Society there : " The importance of the war here prevents my writing to my Government, who have duties of a very different nature to expect from me at present, but you may acquaint the Society that next year . . . . it is my firm intention to shower the most choice productions of Asia upon their island."

Thus, on February 15th, 1791, did Dr. James Anderson express the spirit that always has guided and, doubtless, always will inspire, those whose privilege it is to be connected with an Indian Government Botanic Garden.

THE TROPICAL WORLD.

Sarawak.

United Empire, Vol. XVI. (New Series) No. 3 contains an interesting description of Sarawak and its people delivered by Mrs. Charles Hose before the Bristol members of the Royal Colonial Institute. The lecturer depicted Sarawak as a land of magnificent scenery, inhabited by savages of noble physique living pastoral, and in most respects, inoffensive lives. In the old days before European influence was appreciably felt in the island, the lecturer said, the sleep of the natives was occasionally interrupted an hour before dawn by the yells of an attacking party, and by the flames roaring up from the bundles of shavings thrown beneath the house. Happily, attacks of that kind were no longer made, save in some few remoter parts of the interior where European Governments had not yet fully established their authority. In the past, head-hunting had been the main stimulus to war, but nowadays had sunk to the level of a very manageable superstition, and, as a rule, inter-tribal wars resolved themselves into a hand-to-hand duel after the manner of the Iliad. Anything like wanton bloodshed or relentless pursuit was exceedingly rare. Casualties were usually very limited, for the dense jungle offered abundant opportunities of concealment, and few of the tribesmen preferred to fight to the bitter end if the alternative of flight was open to them. The family life of the tribes of the interior was a singularly healthy one. Polygamy was unknown, the system of slavery was mild. When illness threatened to end mortally, the people had an idea that the soul of the sick person left the body, and means had to be taken to persuade it to return. This was effected by the aid of a professional soul-catcher. The people recognised three kinds of spiritual powers. Alcoholic intoxication was not common. One of the occasions on which drink circulated most freely was on the ceremonial visit of one Chief to another. It was customary for host and guest to make long orations to each other, expressing pleasure at the meeting, touching on local politics, &c., and then apologize for their verbosity by the concluding remark, "Take no notice of what I have said; I am drunk." The cups were then passed liberally round, but scarcely anyone became intoxicated. If a man did become a little too boisterous, these sensitive natives would lead him away at once to sleep off his excitement.

Mrs. Hose gave a sketch of the administrative system of Sarawak. From the beginning, she said, Rajah Brooke associated the natives with himself and his European assistants in the government of the country and made a point of respecting and maintaining whatever was not positively objectionable in the laws and customs of the people. Marked progressive education began some forty years ago with the gradual establishment of both Government and missionary schools.

Southern Rhodesia.

We have recently received the following note from Major H. G. Mundy, Chief Agriculturist for Southern Rhodesia, who has kindly consented to act as honorary correspondent for "Tropical Agriculture."

This Colony, together with Northern Rhodesia and the Mozambique Company's Territory, is passing through a season of exceptionally heavy rains. Already in most parts of Southern Rhodesia the seasonal rainfall has appreciably exceeded the average total precipitation and there are still several weeks of the normal rainy period to go.

Great attention has been given to cotton growing and at the beginning of the season it was estimated that over 70,000 acres would be planted to this crop. Last year, in spite of an unusually low rainfall, cotton yielded exceedingly well, and since few farmers have as yet had much experience of the crop it has this year been planted on all types of soil. On low-lying lands, and where drainage is deficient, the crop has for the most part failed, or is unduly backward, but on the better drained areas the cotton has withstood the adverse conditions well and the outlook is very encouraging.

The construction of ginneries is rapidly being pushed on with, and for one in operation last year there are likely to be nine this year.

At the outset there were good prospects of record maize and tobacco crops, but excessive rains and lack of sunshine have somewhat militated against these chances. However, given favourable weather conditions for the last half of February and throughout March, returns should still be highly satisfactory.

The Colony has recently entered into an agreement with the Imperial Cold Storage and Supply Company, Ltd., for the erection of refrigerating works in Southern Rhodesia for furthering the export of chilled and frozen meat (excluding bacon). It is anticipated that this agreement will shortly exert a most beneficial influence on the price of cattle in the country, will enable farmers rapidly to eliminate their poorer quality breeding stock and will before long result in regular shipments of chilled and frozen beef to the Smithfield and other European markets.

The exhibits of Rhodesian tobacco staged at the British Empire Exhibition were generally agreed to have exceeded in quality and quantity similar exhibits from any other parts of the Empire. British buyers were greatly interested in the leaf and a highly remunerative export trade in both Virginia and Turkish tobaccos is in process of being opened up. Initial shipments have shewn that a good and profitable market exists for even the lower grades of leaf which hitherto have been almost unsaleable in South Africa.

India.

Mr. Wynne Sayer, Secretary of the Sugar Bureau reports that India's production of palm *gur* (raw sugar) during the season 1922-23, the major part of which became available for consumption in the earlier part of the year amounted to 2,953,200 tons against 2,532,500 tons in the previous year while the quantity of *gur* to jaggery which will be available for consumption and refining during the year 1924-25 amounted to 3,103,000 tons. It will thus be seen that the increase in the production of jaggery amounting to 420,700 tons combined with the prospect of an equally good crop next season kept the prices of *gur* very low throughout the year under review and considerably affected the importation of foreign refined sugar in India. India also imported from the countries situated on her borders 622 tons of unrefined sugar, *i.e.*, *gur* as compared with 524 tons in 1922-23. A very small portion of the total putput of *gur* or jaggery is usually exported by sea mostly from Madras Presidency to the United Kingdom, Ceylon and neighbouring countries. The exports of *gur* by sea during the year under review, however, showed a considerable increase amounting to not less than 36,325 tons valued at Rs. 85,81,119, as compared with 2,479 tons valued at Rs. 5,82,282 during the year 1922-23 which was mostly due to the lower prices of jaggery ruling during the year as compared with other raw sugars offering in foreign markets, principally the United Kingdom. The exports of *gur* by land during the year aggregated only 5,513 tons valued at Rs. 12,86,990 against 8,730 tons valued at Rs. 28,26,319 last year.

San Domingo.

Interesting information concerning the sugar crop in San Domingo is given in *Facts about Sugar*, Vol. XX, No. 5. Although rain has fallen practically every day since the 1924-25 grinding campaign commenced on December 15, the mills in southern Santo Domingo have been getting what in the circumstances are to be regarded as satisfactory results from their operations to date. The cane, of course, is backward as a result of the weather—as indeed, is everything else connected with the crop—but the yields have nevertheless been showing steady improvement. Whereas at the start of the campaign they averaged little better than about 7·5 per cent. measured in sugar recovered per weight of cane ground, they have now advanced to only a little under 9 per cent. An average for the entire season to date would probably be close to 8 per cent. Reports of the principal mills for this period show yields of 8·13, 7·86 and 7.65 per cent. The rate at which production is proceeding indicates that the majority of the mills will be able to make their full estimated number of bags of sugar.

Brunei.

In the annual Colonial Report (No. 1238) for the State of Brunei during 1923 Mr. E. E. F. Pretty states that " the year was one of undeniable prosperity and the prospects of the future are still more bright." The most noticeable increase in exports occurred in plantation rubber which rose from 316,989 lb. valued at $91,104 in 1922 to 835,653 lb. worth $363,200 in 1923. The Island Trading Co., the largest employer of labour in the country exported 2,475 tons of cutch during the year to the value of $238,000 compared with 1,726 tons and $172,600 respectively during the previous year. The Company, which is incorporated in England, sent out a forestry expert with a view to the re-afforestation of the mangrove areas which have been wastefully worked in the past. The revenue from Forest produce showed a considerable increase largely due to the almost unprecedented crop of Illipe Nuts in the Belait District. The valuable timber supplies in the interior have, as yet, hardly been touched owing to the difficulties of transport, but the foundation of a Forestry Department is anticipated as soon as the country is sufficiently developed and can afford the necessary expenditure. The lack of an adequate labour supply made itself acutely felt when the price of rubber rose with the introduction of the Restriction Scheme, and holdings, which had lain fallow during the lean years, were again tapped. A revised Indian Immigration Enactment was drafted which it was hoped would make the introduction of Tamil labour a reality.

West Indies.

Mr. J. L. Wilson Goode, H.M. Trade Commissioner for the British West Indies and Central America, has recently published an interesting report on the Economic and Financial Condition of these countries.

Except Bermuda and the Bahamas, the chief industry of the Colonies in this area is agriculture. The staple products are sugar, cocoa and fresh fruit, consisting chiefly of bananas, oranges and limes.

During recent years both the sugar and cocoa industries have suffered from depression. In 1923 the sugar industry showed a marked improvement, as compared with the two previous years, but in March, 1924, values declined very considerably. The cocoa industry of the British West Indies remains (November, 1924), in a parlous condition which is a source of anxiety to those Colonies largely dependent upon the industry, prominent among which are Trinidad and Grenada. The decline in the local industry is ascribed largely to the greatly increased production of the cheaper cocoa grown in West Africa.

The coconut industry (a subsidiary industry of great importance to many of the Colonies) has suffered a good deal from disease, but well-managed estates in favourable locations have produced good returns.

The banana industry of Jamaica had a good year in 1923. Despite bad weather, the crop was the highest on record in point of both quantity and value.

The lime industry of Dominica, upon which the island depends for its very existence, has never recovered from the outbreak of withertip disease in 1922. The crop losses during 1923 were so heavy that planters are now compelled to turn their attention to other products.

As a consequence of the decline in the staple industries, close attention is being directed to the cultivation of tropical fruits, including pineapples, an industry which is capable of considerable development providing that adequate cold storage facilities can be obtained in the steamers operating between the United Kingdom and these Colonies.

A reduced demand for luxury articles has militated against the demand for Sea-Island cotton, which is now grown almost exclusively in the West Indies.

Cuba.

Those engaged in the sugar industry of Cuba view the prospects of the present year with considerable apprehension. Under the stimulus given by Mr. Hoover, the Food Administrator for the U.S.A., during the war, Cuba increased her output of cane sugar from approximately 2½ million tons to 4 million tons. Following the collapse of the artificial boom during 1920, sugar subsequently rose to an average of 4·9 cents per lb. in 1923 and the total crop of 3,645,967 tons of sugar realised $400,181,383. Stimulated by this profitable price, production in 1924 rose to 4,112,699 tons valued at $368,497,830, an average of 4 cents per lb. The year 1925 opened with the prospects of a new record crop, threatened strikes, a general labour shortage, and unprofitable price levels. The action of the Government has tended to allay anxieties regarding the labour situation but the price level for sugar, varying now between 2½ to 2¾ cents per lb., points to a disastrous year. Only the most advantageously situated and up-to-date factories can hope to clear expenses with sugar below 3 cents, and the great majority of planters and factory-owners are confronted with the prospect of heavy losses which in some cases may prove fatal. The cost of labour is an appreciable factor in production since 50 per cent. of the labour force has to be obtained from abroad and, consequently, labour saving devices, such as the tractor drawn plough, and cheap and efficient transport, are receiving considerable attention. Experiments are to be conducted with a mechanically propelled machine devised for cutting, topping and loading cane as it passes down the row. One need hardly emphasize the fact that when this machine comes within the realm of practical accomplishment it will do more to secure the stability and prosperity of the Cuban sugar industry than any other single factor. Producers are very concerned about the attitude to be adopted in the U.S.A. tariff. Failing some fundamental change in the situation 1925 promises to be a most unfortunate year in the history of Cuba.

Gold Coast.

In these days when so much attention is being focussed on Cotton Growing within the British Empire, it is distinctly encouraging to note that the exports of cotton from the Gold Coast for the year 1923-24 are the highest recorded since 1885—131,295 pounds of cotton valued at £2,703 being exported. It appears that the chief disadvantage with the present type of cotton in general cultivation there is the length of time taken for the crop to mature, and an effort is being made to select a strain which will mature its crop in a shorter time. This of course will take a considerable amount of time but undoubtedly it is a step in the right direction. The exports of Copra, 1,305 tons, though not quite so high as last year 1922-1923, are nevertheless much higher than for many preceding years and interest in the valuable Coconut Palm is being aroused with Coast Area planters and even farmers further inland. Thousands of acres of land suitable for Coconuts are available so that greater exports of Copra are predicted in the future.

The Sisal Factory at Accra is now completed and has commenced operations, being now linked up to the Beach by means of a branch line from the Weshiang Railway.

Considerable damage is still being done by the promiscuous chopping down of the Oil Palm for purposes of wine making and is stated likely to continue so long as the African has a taste for Palm wine.

A good feature of the propaganda work which is being carried on is the fact that, in a number of cases, Chiefs have become sufficiently enthusiastic in regard to planting. This applies more particularly to the Eastern Province and Ashanti where an attempt has been made to conduct systematic planting of the Oil Palm. Again on the other hand some Chiefs have passed Bye-laws in which it is laid down that for every palm tree cut down, at least two seedlings shall be planted. Tapping experiments on the standing palm were carried out but with no marked success, in every case the yield of wine was less and in some cases the palms ultimately died. During the year 1923-24, over 408,000 gallons of Palm oil were exported, being an increase of 109,000 gallons over the preceding year.

Mauritius.

The industries of the island are entirely agricultural; there is no mineral wealth of any importance. The whole interests of the Colony are bound up in the sugar industry and practically the whole of the land suitable for growing sugar-cane is under that crop. The area at present under cane cultivation is about 171,000 acres or about one-third of the total area of the Colony and the average production for the past five years nearly a quarter of a million tons. With

the exception of British India, Mauritius is thus the largest sugar producer among the British possessions. Altogether there are 50 sugar factories ranging in productive capacity from 1,500 tons to 15,000 tons, the majority of which are modern factories, the standard of equipment being constantly improved.

A striking feature of the sugar industry in recent years has been the rapid increase in the area cultivated by Indians who are a preponderating element in the population, forming over two-thirds of the total. At the end of 1923 the area cultivated by Indians was estimated to be 73,600 arpents (76,760 acres) or nearly 45 per cent. of the total cane cultivation, the figure having almost doubled since 1909.

The low quotations for sugar coupled with the high cost of labour, have led since 1921, to a reduction of about 5,000 acres in the total area under cane cultivation. In facing the labour problem considerable attention was paid to mechanical cultivation, and a number of farm tractors of various types continues to be introduced into the Colony.

The Sugar Planters Syndicate, which was formed in 1920 and was re-constituted under Ordinance No. 7 of 1921, disposed of the local sugars to private buyers on a co-operative basis.

In 1919, the record year, the exports of sugar reached 302,826 tons, valued at Rs. 125,103,000. The quantity fell in 1920 to 182,465 tons but the value was Rs. 124,634,000. The value of the sugar exported in 1921 was Rs. 154,592,000 for 229,225 tons exported, the figures for 1922 and 1923 being Rs. 88,454,000 for 292,744 tons, and Rs. 67,227,000 for 223,051 tons respectively.

The countries to which the bulk of Mauritius sugar is exported are the United Kingdom and to a smaller extent, India.—(*Annual Colonial Report No.* 1234.)

St. Lucia.

According to the Annual General Report for 1923, there was a decrease in the sugar output for that year, though prices were somewhat better. There was also a decrease in the quantity of rum made at local distilleries. Both the cacao and lime industries were in a very depressed condition prices having been low for the greater part of the year. As a result of this the gathering of limes was indifferently carried out and export suffered accordingly, though large quantities of green limes were exported. The exports of coconuts and copra for the year, however, show a satisfactory increase as planters are beginning to realise the value of extending this crop. Nutmegs (and mace), though not very extensively grown, proved a satisfactory export crop while some progress was made in the planting of tobacco, camphor, African oil palm and sisal hemp. Increased interest has been shown in the cultivation of Sea Island cotton. There are considerable areas suitable for this crop which so far are free from "pink bollworm." Extensive banana cultivation, a new and important industry, was started and already labour has benefited considerably, approximately 400 men and women being employed regularly during 1923 in clearing hillside and forest. An attempt was made to arouse interest in castor oil production, and the establishment by private enterprise in 1924 of a coconut and castor oil mill, will, it is hoped stimulate the interest of growers.

The working of Agricultural Credit Societies during 1923 was most unsatisfactory. The advances were almost without exception used to pay off interest on heavily mortgaged properties and not for the extension and improvement of cultivation as intended. These Societies were being dissolved as rapidly as advances were repaid.

Foochow.

The most important foreign trade in Foochow, the capital of Fukien, China, is in tea, which is grown largely in the northern and western sections of the province. Tea from the western interior is transported by means of small river-boats, and that from the northern regions by launch, all centering at Foochow, which is the export market for Fukien. Generally, the tea grown in the province may be classified as green, black and brick tea. Little green tea is exported to Western countries, but the black tea produced is of very good flavour and much appreciated in foreign countries, exports going chiefly to London, Continental ports, America and Australia. There used to be a great demand for brick tea for Russian markets, but business is practically at a standstill at present. According to a recent bulletin issued by the Chinese Government Bureau of Economic Information, another important article of export from Foochow is timber, including planks and poles of pine and soft wood. It is mostly sent to Japan. Fukien timber is considered to be better for building purposes than that of any other place in China, and it is estimated that the total export of timber from Foochow amounts in value to over ten million dollars annually. Amongst other industries of the port may be mentioned the production of handmade articles, such as lacquer ware and paper umbrellas, which are known all over the world. Paper umbrella exports go chiefly to London, America and the East Indies. Other industrial works in Foochow are a match factory, soap factories and cloth weaving houses, and there is a leather tanning factory, and one for spirit-brewing, while two rubber factories are being established and will supply rubber soles for local consumption. Other important products in Fukien province are bamboo, bamboo-shoots, Chinese paper, fruit and camphor, the export of which is chiefly to other Chinese ports. Foochow's principal imports are cotton and silk fabrics, flour, sugar, kerosene, metals and manufactured articles. Exports from Foochow last year were valued at Hk. Tls. 23,409,852, and imports from foreign countries at Hk. Tls. 8,775,017 both of which showed a marked improvement over the trade of the previous year. —(*Chamber of Commerce Journal.*)

SYNTHETIC FARMYARD MANURE.

PROF. F. HARDY, M.A.

THROUGH the courtesy of Mr. E. Hannaford Richards, B.Sc., F.I.C., Managing Director of the Agricultural Developments Company, we are able to publish further details of the ADCO process, and to make certain amendments to former articles which have appeared in this Journal (Vol. I, No. 8, August, and No. 9, September, 1924, pp. 116 and 133).

At the outset, it is necessary to state that the proprietors of the ADCO process now desire to describe their product as *synthetic* rather than artificial manure, since this term has given the erroneous impression that the material is of an inorganic or chemical nature, whereas actually it comprises very nearly the same components as farmyard manure (in particular the valuable organic matter), with the difference that its ingredients have been synthesized or built up from the same main raw material as farmyard manure by the agency of added bacterial stimulants, but without the intervention of farm animals.

As a result of recent investigations, it has been demonstrated that the decomposition of plant residues through the activity of micro-organisms, takes place in several stages. First of all, sugars, pentosans and starches are consumed by a variety of organisms, notably fungi. It seems likely that these carbohydrates are built up into living cell material (protein), which is itself broken down at a later stage, providing the most available type of organic matter in the finished manure. Cellulose itself decays comparatively slowly, and may be regarded as a "scaffold" supporting and distributing the decomposition products of the other simpler carbohydrates. Contrary to former opinion, it has also now been proved that reducing sugars in moderate amount, and higher nitrogen compounds (if not bactericidal), actually assist rather than hinder the formation of a satisfactory manure.

In common with all living plants, the micro-organisms concerned in cellulosic fermentation, require nitrogen for their sustenance. Frequently, the amount of nitrogen contained in the raw material upon which they act, is insufficient for their needs. Consequently, it is necessary to add nitrogenous compounds to augment the supply naturally present, if a satisfactory fermentation is to be obtained. In the case of cereal straw, usually 0·7 per cent. of nitrogen, measured on the dry weight of the straw, is required to make up this deficit. For cane trash, the necessary amount is probably nearly the same. The additional nitrogen may be supplied in the form of some inorganic nitrogenous compound (ADCO process), or as urea contained in the urine of farm animals (Mauritian method, as well as the ordinary farmyard or pen manure process).

In their earliest experiments, the Rothamstead investigators used ammonium carbonate as a source of nitrogen, but for reasons of cost, sulphate of ammonia was employed in later large scale trials. This gave fairly good results, but its sulphuric acid content was objectionable, while the high solubility of the salt led to accidental loss in distribution. Mr. Richards states that for two years past the ADCO Company has manufactured its own reagent which contains no sulphate of ammonia. The new reagent ensures a neutral or slightly alkaline fermentation, while the phosphate-nitrogen ratio in the finished manure is greatly improved. The formula of the reagent has not yet been divulged.

The extent to which fixation of *atmospheric nitrogen* may proceed during the manufacture of synthetic manure, through the agency of specific micro-organisms, has apparently been unduly exaggerated. Mr. Richards' laboratory experiments, commenced in 1915, and repeated with the co-operation of Dr. Hutchinson in 1918-19, have conclusively shown that, even under the most ideal conditions, the actual gain due to the fixation of atmospheric nitrogen, seldom exceeds 0·5 per cent. of the dry weight of the straw employed as raw material. Usually it is much less. In large scale trials with straw heaps, the maximum gain was found to be only 0·1 per cent. Thus little additional advantage can be expected from the co-operation of atmospheric nitrogen fixers.

In the manufacture of synthetic manure by the Mauritian method, the writer found that the increase in nitrogen over that contained in ordinary Trinidadian pen manure, was only about 0·036 per cent. of the weight of the final manure, or about 0·156 per cent. of its dry weight, which amply agrees with Mr. Richards' experience.

The fact that the increase in nitrogen due to atmospheric nitrogen fixers is relatively small, is explained on the grounds that there is usually only a limited amount of suitable carbohydrate (sugar, pentosan starch), available for the nourishment of the micro-organisms that can assimilate either atmospheric nitrogen or chemically combined nitrogen, and that, when this supply has been exhausted, no further assimilation can occur. Consequently fermentation then proceeds very slowly.

On the other hand, if the supply of suitable simple carbohydrate in the raw material is considerable, but at the same time, the amount of nitrogen present in the manure is insufficient, the nitrogen assimilating micro-organisms may draw on the reserves of nitrate nitrogen *in the soil*, and the manure may then exert a depressing effect on crop yield when first applied to the land. Herein lies the danger of employing too much cellulostic litter in the manufacture of ordinary farmyard manure, and indeed of Mauritian pen manure also.

For obvious reasons, it is not easy to arrange the proper balance of nitrogen to carbohydrate when manure is made by treading litter under stock. On the other hand, once the normal composition of the raw material has been determined, the ADCO process enables a well-balanced manure

to be produced without any risk of those losses of valuable fertilising constituents which are generally recognised as inevitable under the older systems.

This, then, is the secret of the ADCO process. By means of a long series of laboratory experiments augmented by numerous large-scale trials, the Rothamstead workers have gradually evolved a formula and a mode of operation which yield results that are highly satisfactory in respect to the manurial quality of the final product. It only remains to be seen whether or no the use of ADCO synthetic manure compares favourably with other systems of manuring when considered in economic aspect. Various trials are being made, not only in Great Britain, but in many tropical and sub-tropical countries as well, in order to settle this question, and it may interest our readers to learn that large scale trials will probably soon be inaugurated in Trinidad under the joint auspices of the Trinidad Department of Agriculture and the Imperial College of Tropical Agriculture. The results of these trials, when available, will be published in this Journal.

RAINFALL AND CROP YIELDS.

With particular reference to Cacao in Trinidad.

W. R. DUNLOP, late Professor of Economics at the Imperial College of Tropical Agriculture.

[*In the following article published in "Nature," No.* 2884, *Vol.* 115, *Professor Dunlop gives the general results of his investigations, carried out at the Imperial College of Tropical Agriculture, into the correlation between Rainfall and Crop Yields.*]

AN important feature of modern economic geography is the study of the relationship between climatic conditions and industry. Regarding climate and weather as being respectively the static and dynamic aspects of meteorological conditions, we have in the tropics, as Dr. Martin Leake has recently emphasized, climate a determinate factor in the location of industries and colonies of people; weather, on the other hand, is frequently the most important factor underlying local industrial *variation*. In the tropics, rainfall is generally the chief weather factor affecting crop yields, and in Trinidad (West Indies) the writer has given some attention to the relationship between variation in rainfall and yield of cacao—the island's principal product. This work has definitely established the fact that the annual variations in yield, which may deviate as much as −101·8 per cent. of a 5-year moving average (River Estate, 1921-22), are fundamentally due to variations in rainfall, though the exact extent of the connexion has not been statistically determined in all cases.

The procedure followed in the investigation was to obtain monthly rainfall and monthly crop-yield records for as many years back as possible (generally not more than 15) from the most reliable individual estates and to work on the data for each estate separately. Finally the annual output of cacao for the whole island was considered in relation to the average annual rainfall for all cacao districts. On the whole, I am satisfied that the data obtained are sufficiently trustworthy for the purpose of affording general indications.

It will be well to emphasize, however, that studies like the present one cannot be regarded as purely statistical: we are dealing, not with the rainfall itself but with its ultimate effects, and it is necessary to have at least an elementary knowledge of the physiological nature and habits of the cacao tree (in this particular study) in order to anticipate lags and to deal intelligently in general with the data. There is also the question of increasing or declining output as affected by agricultural management. The latter difficulty is partly overcome by plotting the yield deviations from moving averages for, say, 5-year periods. In general the "dot chart" method of plotting yield against rainfall to indicate linear correlation was employed, and in cases where the points clustered adequately, the coefficient of correlation was computed. In all cases the percentage deviations from the averages were plotted as well, in order to compare the magnitude of the variations on the same scale. It is not possible in this short note to reproduce the graphs and all the computations, but they are available for reference The following table gives the general conclusions arrived at:

Estate.	Geographical location.	Av. ann. rainfall in. (approx.)	Correlation: Yield and rain of "wet" months.	Correlation: Yield and Nov. rain.
La Vega ..	Central Range ..	84	Negative	None
Non Pareil ..	East end of N. Range	95	Negative	Positive
Verdant Vale ..	Central N. Range ..	85	Negative	Positive
River	West end of N. Range	67	(Inconclusive)	(Inconclusive)
All cacao Districts.	North, Central and S.E.	73 (weighted)	Positive within limits	(Undetermined)

It would appear that estates with an average annual rainfall of 80 inches and more are less adapted for cacao, other things being equal, than estates with an average annual rainfall lying between 70 and 75 inches. In the case of La Vega estate the negative correlation was found to be extremely definite, the highest and most remarkable coefficient being in respect of the May and June rainfall and the subsequent crop. This was found to be $-0{\cdot}95 \pm 0{\cdot}10$. It is necessary to mention that this computationwas made under my direction but that I have not verified it. For the rainfalls of May only, however, and subsequent yields, I myself obtained a coefficient of $-0{\cdot}85 \pm 0{\cdot}15$, which is equally, if not more surprising, because it refers to one month of the year only, and that six months prior to the coming in of the crop affected.

Verdant Vale estate has a coefficient for November rain of $0{\cdot}65 \pm 0{\cdot}05$. The apparent importance of adequate rain during November in the Northern Range of hills is interesting, and this and many other points require further study.

Generally speaking, rainfall seems to be a fundamental factor underlying the whole economic activity of Trinidad. A close connexion was found by the writer between rainfall in Port-of-Spain and the electric tram-car takings, and between the business done in the shops. The latter is partly due to synchronic weather changes, and partly the effect of the previous year's rainfall and crop yields affecting the purchasing power of the inhabitants.

On the principal rubber estate I found the well-known connexion between daily rainfall and the quantity of rubber tapped from the trees. The connexion here is due to purely physical reasons, rain causing the latex to flow over the bark instead of down the central channel into the cup. The influence of rainfall on sugar-cane and coconut yields was not studied, but it may be of interest to mention that considerable work on the former relationship has been done in other countries. The most important, perhaps, of this work is A. Walter's analysis of climatic factors and the cane crop in Mauritius, that of M. Kœnig in the same Colony, and the work of T. A. Tengwall and C. E. van de Zyl in Java, which has recently established a positive correlation between sugar yield per bouw and amount of rain in October and November. A very good summary of the results obtained in the United States in regard to weather factors and cotton Indian corn (maize) and tobacco, is to be found in J. W. Smith's "Agricultural Meteorology." Most of the correlations obtained in connexion with rainfall and tropical and sub-tropical crops have been in the neighbourhood of 0·60 with probable errors indicating a fair degree of significance.

In conclusion, I should like to emphasize the importance of this work not only from the point of view of physiology and agriculture, but also from the wider point of view of economic geography. Conditions in tropical countries have, for the most part, been fully described; what is needed now is statistical analysis and co-ordination, and from a broad administrative point of view. In Trinidad the general complaint is that short cacao crops are due to drought. On many of the best and largest estates my work indicates that the trouble is the result—or partly the result —of too much rain.

CHEMICAL NOTES.

(Compiled by the Department of Chemistry and Soil Science).

Forced Colouring of Citrus Fruits.

In the February (1925) number of this Journal an account was given of a valuable method discovered and applied in California for hastening the colouration of ripe oranges, lemons and grapefruit. As a sequel to that article, the following statements, which appeared as an editorial in *Industrial and Engineering Chemistry*, March, 1925, p. 224, under the caption "Chemistry Misused," are extremely significant.

The editorial article states that "it too frequently happens that gains made by applied science are lost through the misapplication of the new found knowledge. A case in point is the use of ethylene, kerosene and other rê-agents for artificially colouring citrus fruits, which, though ripe, do not naturally acquire the colour demanded by our fastidious market. The ripeness of such fruit can be determined in the chemical laboratory, and it is a boon to the industry to have these artificial colouring methods lawfully applied when the fruit is ripe enough to market."

"The early markets bring the best prices. It is not surprising, therefore, that this temptation proves too great for some who have not hesitated to employ these fruit-colouring methods with fruit that is both green in colour and unripe. The problem is having the serious consideration of state and federal authorities, and meanwhile the fair-dealing fruit growers, who find confidence in their products destroyed through the sale of unripe fruit, are considering the passage of laws to prevent the use of the new-found method under any circumstances. Once more, short-sightedness threatens to negative advantages gained through research."

This instance of the unscrupulousness of a certain section of a community, recalls the case of the misuse of clay as a protective and adsorptive covering for cacao beans, that recently became the subject of much bitter comment amongst Trinidad planters, who were forced, in consequence, to abandon a practice that had much to commend it. One would think that there is hardly a penalty severe enough to deal with offenders of this type.

The Colouring Matter of Lime Juice.

In an article appearing in the January number of *Industrial and Engineering Chemistry* 1925, F. Hardy and F. H. S. Warneford, describe the results of their investigation of the relationships and properties of the colouring matter of lime juice, in especial connection with the manufacture of citrus products such as lime juice cordial, concentrated lime juice, calcium citrate, citric acid syrup and citric acid crystals. They show that the well known colour changes that occur when lime juice is stored in contact with air, or is concentrated or neutralized with lime in the presence of air, are due largely to the oxidation of a polyhydroxy-phenolic substance, akin to certain tannins.

The original colouring matter is of a yellow, but not intense, colour, and occurs mainly in the outer rind of the lime fruit, from which it is expressed during milling, becoming mixed with the juice from the pulp cells. Its oxidation products possess a deep brown colour, and exhibit decreasing solubility in water according to the degree of oxidation. Thus, on concentrating acid lime juice by vigorous boiling in open vessels, the colouring matter may be precipitated as an almost black substance of the nature of a phlobaphene, and in this way, it may partially be eliminated. Under conditions of alkalinity, such as obtain when lime juice is treated with an excess of lime in the manufacture of calcium citrate, oxidation of the colouring matter proceeds very rapidly, and, if the separated calcium citrate is not immediately and thoroughly washed, the oxidation product may seriously contaminate the citrate, in which it may become fixed by further oxidation that results in the formation of tarry residues.

The manufacture of fructose sugar.

Fructose (levulose, or fruit sugar) is the sweetest known sugar, being about 50 per cent. sweeter than cane sugar. As the name implies, it occurs naturally in many fruits. It is also produced when cane sugar is hydrolysed (or "inverted") by acids. Syrups and molasses therefore contain an abundance of fructose sugar. Honey also is rich in it. Nevertheless pure *crystalline* fructose is a rare chemical compound, although hundreds of tons of the sugar, contained in these commodities, are consumed annually.

Fructose can readily be obtained from a starch-like substance, inulin, which occurs in abundance in the tuberous roots of the Jerusalem artichoke, dahlia, chicory, and many other members of the plant family Compositae. All that is necessary is to heat inulin with a dilute acid in order to convert it into fructose. In this way, about 12 parts of fructose can be obtained from 100 parts of artichoke tubers. The sugary solution, however, can seldom be induced to deposit crystals of fructose by evaporation, because of the inhibiting effect of small amounts of impurities in the liquor.

By precipitating fructose at freezing temperature with lime (with which it forms an insoluble compound), and then decomposing the lime compound with acid, Jackson, Silsbee and Proffitt,* of the Bureau of Standards, Washington, U.S.A., have been able to obtain pure crystalline fructose with a facility approaching what with which cane syrups yield sucrose crystals. The process elaborated by these investigators, as applied to the production of fructose from artichokes, appears to offer complete commercial success, and doubtless in the near future it will be possible to purchase pure crystalline fructose for one or two shillings a pound instead of between one hundred and four hundred shillings a pound, which is the present market price.

Formic acid as a Coagulant for Rubber.

Until recently, it has been supposed that the efficiency of formic acid is less than that of acetic acid as a coagulant for rubber latex. The recent investigations of Dr. A. P. Stevens,† the consulting chemist of the Rubber Growers' Association, have shown the error of this supposition, for it was found that, whereas one part of pure acetic acid is required to coagulate 1,200 parts of rubber latex, one part of pure formic acid is capable of satisfactorily coagulating as much as 3,200 parts of latex. Reports from Ceylon support these findings as applied to plantation conditions, although the relative efficiency of the two coagulants was not found to be quite so large as the laboratory experiments indicate. The vulcanizing properties of the rubber separated by formic acid treatment were found not to differ appreciably from those of rubber separated by the use of acetic acid. The relative cost of the acids is £48 3*s.* 0*d.* per ton for 90 per cent. formic acid, and £56 10*s.* 0*d.* per ton for 90 per cent. acetic acid, so that, considering that formic acid is approximately twice as efficient as acetic acid in the coagulation process, the cost of the process is reduced to about one-half when formic acid is substituted for acetic acid.

Formation of Humus and Humic acids in the Soil.

The formation of the so-called humus and humic acids in the soil is now explained by four different theories (*a*) formation from lignin, (*b*) from furfural, derived from pentose sugars, (*c*) from protein amino-acids interacting with sugars, and (*d*) by the oxidation of phenolic compounds. Each of these initial substances is known to occur in plant residues, or in their natural decomposition products. According to H. J. Page, Chemist at the Rothamsted Experimental Station, normal cellulose is not responsible

* *Indus. Engin. Chem.*, Dec., 1924, p. 1250.

† *Bulletin Rubber Growers' Association*, 1924, Vol. 6, No. 11, .197 ; 1925 Vol. 7. No. 1, p. 51.

for the formation of humic acid. On the other hand, lignin, which is a component of ligno-cellulose comprising woody substance, on oxidation, yields a brown product closely akin to humus. Proteins probably play only an indirect part in the formation of humic substances. Pentosans (which are complex products of association of pentose sugars, and comprise the main components of natural gums) yield humus-like substances under certain conditions of decomposition, and are probably of great importance in the formation of the complex soil organic matter commonly called humus.

Molasses and Vitamins.

Those concerned in the vitamin contents of various foodstuffs from the point of view of their efficiency as body builders, will be interested to learn that tests carried out at the Iowa State College by Messrs. Nelson, Heller and Fulmer,* on the relative vitamin contents of various kinds of molasses, have established the fact that sugar-cane molasses (blackstrap) is much richer in vitamin B than either beet molasses or sorghum molasses.

Vitamins are accessory food substances whose presence in small amount is essential in an entirely satisfactory diet or ration, that is otherwise well balanced with respect to protein, carbohydrate and fat. Three main types of vitamin have so far been described. They are :—

(1) *Vitamin A*, soluble in fat, and plentiful in butter, milk, egg-yolk, cod-liver oil, and green vegetables. This vitamin is known not to be present in cereal grains, sugars or refined vegetable fats, and its *absence* from sugar-cane molasses, as well as from beet molasses and sorghum, was verified by the workers whose positive results have been quoted above. A diet that does not contain vitamin A, inhibits proper growth in young animals, and, in extreme cases, may cause rickets.

(2) *Vitamin B*, soluble in water, occurs plentifully in the outer layers of whole cereal grains, in leguminous seeds, juicy fruits, yeast and green vegetables, but not in milled flour, nor in polished rice. Deficiency in vitamin B leads to skin eruptions and beri-beri.

(3) *Vitamin C*, soluble in water, is especially plentiful in citrus juices, tomatoes, and most other fruits and vegetables. Its absence from food causes scurvy. It is easily destroyed by heating, drying or ageing, except in the case of the more acid fruits.

Recently it was announced that lime juice was not so rich in vitamin C as lemon juice, but this statement has been hotly contested in a recent number of the *West India Committee Circular* (No. 689, February 26, 1925, p. 81), which attempts to prove that the error is due to a grave misunderstanding.

* *Indue. Engin. Chem. Feb.* 1925, p. 199.

BOOK REVIEWS.

COTTON IN SOUTH AFRICA. By W. H. Scherffius, M.SC., and J. du P. Oosthuizen, M.SC.—The authors of this book are respectively Chief and Assistant Chief of the Cotton and Tobacco Division of the Union of South Africa, and at the outset we should be justified in expecting a high standard both of the type of material contained therein, and in its method of presentation. Such expectation, however, is not fulfilled.

In the Preface the authors state that the book is intended for cotton planters and as a textbook on the subject of cotton culture for the use of students in Schools and Colleges. The range of subjects dealt with is wide, and includes chapters on cotton production in South Africa, Botanical features of cotton, Cotton varieties in South Africa, Cotton varieties, Cotton breeding and the chemistry and microscopy of the cotton fibre.

In dealing with the cultivation and handling of cotton the authors have done their work creditably, though one would wish that adherence to purely American methods were not quite so slavish, and that the vast amount of information accumulated in Egypt, India and the West Indies had been made more use of.

But on undertaking a survey of the sections on the Botany, Breeding, and Selection of Cottons one wonders why the authors bothered to disinter long since discarded methods from ancient Bulletins, written mostly before the foundation of modern genetics and crop physiology were laid. The authors have apparently never heard of a "Pure Strain," and they cover page after page with either misleading or absolutely inaccurate statements.

A few of the more glaring examples will suffice :—

p. 39. "Vegetative or primary branches . . . . . are more or less sterile, bearing few if any fruit, but fruiting stems often spring from the axils of primary branches."

Fruiting branches on secondary vegetative branches do not spring from axillary but from extra-axillary buds.

p. 40. "The ovary is three-celled in Sea Island and allied species, and four-celled or five-celled in Upland."

Sea Island may have up to 60 per cent. of bolls with four loculi and 2 per cent. of bolls with five loculi. Uplands may have a large proportion of three-locked bolls, Egyptian often have 10-20 per cent. of 2-locked bolls.

p. 51. "Uniformity must be maintained by selection, otherwise the variety will deteriorate in a comparatively short time."

Not at all : Why breed out pure lines if this is the case ?

p. 59. "Twists" should be reserved as a descriptive term for yarns, and the term "convolutions" for cotton hairs.

p. 59. "Likewise, there is a wide variation in the strength of the individual mature fibres of the different varieties of cotton. One writer described these differences as being able to take a strain ranging between seventy-five and three hundred grams."

The reviewer must confess to a total inability to understand what is meant here. The breaking load of single cotton hairs varies from 3-7 grams. How can a difference take a strain ?

p. 60. A deposit of reddish oil-like substance is stated to be one of the four or more distinct parts of the cotton fibre

The structure of the cotton hair has been ably dealt with during the last few years by Balls, Denham, and others ; it is sufficiently clear that the above statement is inaccurate.

p. 87. No data on the probable error of the manurial experiments are given and the deductions drawn from them are not subjected to statistical treatment.

p. 167. Dealing with the cotton stainer as a pest, the hoary fiction is repeated that a certain amount of staining may be caused by the stainers fouling the lint, and by their bodies being crushed in the gin.

The authors are apparently unacquainted with Nowell's work in the West Indies, in which he established that the chief damage done by stainers was a result of introducing into the boll by their punctures the fungi and bacteria of Internal Boll Disease.

To sum up : the authors have presented a fairly good account of the agriculture of cotton in South Africa but have dealt wrongly or inadequately with the botany, breeding, and selection of cotton, and with the properties of cotton fibres, apparently through ignorance of what has been published.

The price of the book, 21s. for 207 pages seems excessive, and there are a number of misprints.

S. C. HARLAND.

"GARDENING IN THE TROPICS." BY R. O. WILLIAMS (Superintendent of the Royal Botanic Gardens and St. Clair Experiment Station, Trinidad). Printed by the Government Printer, Trinidad, Pages 64. Plates 15, Price 2/-.

"GARDENING IN THE TROPICS."—This little book written especially for School Gardens in Trinidad and Tobago, and published by the Trinidad Agricultural Department, is full of interest and useful suggestions.

The Director of Agriculture in the Preface says "The book, which is intended primarily for the use and guidance of teachers, has been prepared at the suggestion of the Director of Education, and it is hoped that it will enable the work in the school gardens to be more effective. Moreover, as the conditions and work to be done in the ordinary vegetable and flower gardens are very similar to those of school gardens it is hoped that the volume will be a useful guide to many gardeners who have not at present any book of reference."

The hopes expressed for the usefulness of the book ought to be realised, for the teacher with an interest in gardening who will make himself familiar with its contents, should have no difficulty in developing an enthusiasm on the part of his pupils, while the amateur gardener will find within its pages many valuable hints.

The chapters on preparing the soil, drainage and in particular on manuring are of the utmost importance. Children should not only be told, but should be made to see, the advantages to be derived from these operations and brought to realize the benefits which come from the use of all the common kinds of manure, and the need for carefully saving and utilizing everything of the sort. The need for good fencing is emphasized, and there is no doubt that one of the greatest drawbacks to successful school gardening not only in Trinidad but in other West Indian Islands, is to be found in the difficulty of protecting the garden in its early stages from the depredations of the fowls, donkeys, and goats of the neighbourhood.

The book is nicely got up, and the illustrations which are presented in 15 plates are very good, including plans of gardens, illustration of methods of grafting and budding and of insects both injurious and beneficial.

H. A. BALLOU.

"AFRICA." By E. Lewin, M.B.E., Librarian of the Royal Colonial Institute, Oxford: the Clarendon Press, 1924, pp. 223.

The fact that this book comprises little more than 220 pages printed in large type prevents the reader from expecting any detailed description of such an immense subject, but within the limitations imposed by space Mr. Lewin has compressed a remarkable amount of information written in a pleasing style. The arrangement of the matter is highly satisfactory and presents an object lesson which authors of more pondrous tome might well endeavour to emulate. The main subjects such as physical features, ethnology, economic devolopment, &c., are dealt with from the continental point of view irrespective of political divisions. The 19 maps and diagrams and the 29 photographs illustrating the text have been chosen with considerable care. As a general introduction to a highly complex subject the book can be recommended with every confidence. It would be a distinct improvement if in all future issues Mr. Lewin included one of those bibliographies in the compilation of which he excels.

C. Y. SHEPHARD.

"WHAT EVERY BRITON OUGHT TO KNOW."—By Ben H. Morgan with a foreword by the Rt. Hon. Stanley M. Bruce, M.C., Prime Minister of Australia. London: P. S. King & Son, Ltd., pp. 98. Price 3/6d. with paper covers.

This little volume is composed of nine short chapters on various aspects of Empire relationship and Empire development, eight of which were broadcasted from the London 2LO Wireless Station by the author, Mr. Ben H. Morgan, who, incidentally, is Chairman of the British Empire Producers' Organisation. As one would imagine from the broad nature of their appeal, these brief sketches are written in plain, simple, but interesting language. The many Britishers who know little, but are anxious to learn something, about the great Empire to which we all owe allegiance will find this book an interesting and helpful companion.

Mr. Morgan asserts that the great Commonwealth of Nations, known as the British Empire, is not destined to share the fate of the other great Empires of the past since each constituent part possesses the "seeds of life and growth" which are not crushed, as in other Empires, by the dominance of the Mother Country. On the contrary, Great Britain attempts to shape the destinies of the backward dependencies so that eventually they may attain the status of freedom enjoyed by the more progressive elements, such as the self-Governed Dominions.

But the development of the Empire depends in large measure upon the ability and willingness of Great Britain to assist in a strong progressive policy. As the Rt. Hon. Stanley M. Bruce points out in his short but able preface "the strength, the safety, perhaps even the existence of Great Britain as a power in the world is dependent upon the full development of the resources of the Empire." Mr. Morgan has no qualms about the future but views it with hope and encouragement. "The British Empire is like a young and vigorous family, high-spirited and full of energy, its errors are the errors of its qualities not the failings of decadence and decline."

No less than 88 pages (or one-half of the book) are devoted to four appendices containing historical notes on the development of the British Empire preferences; preferential arrangements with the Colonies of Foreign powers: a bibliography of the principal recent publications on the British Empire and some British Empire statistics, each of which is carefully compiled and full of interest. Those readers who wish to delve more deeply into the subjects briefly dwelt on will find the bibliography prepared by Mr. Evans Lewin, M.B.E., an excellent guide. While we may disagree with some of the things Mr. Morgan has to say, everyone will admit that it is a stimulating production, particularly, those who have not had the opportunity of studying the fascinating story of Empire development in any detail.

C. Y. SHEPHARD.

HANDBOOK OF THE LEEWARD ISLANDS.—Compiled by F. H. Watkins, I.S.O., pp. 308, $8\frac{1}{2} \times 5\frac{1}{2}$ (London: The West India Committee, 1924). Price 10/6.

This is a useful addition to the collection of handbooks lately issued for various Colonies and Protectorates. A well-written, comprehensive account of the history, economic development and political conditions of the Leeward Islands is given, obviously the result of many years study. It is pleasing to note that more space is given to the geology, flora and fauna of the islands than is usual in books of this type, and that this information is partly derived from the latest published researches. The historical section, which occupies nearly seventy pages, gives an interesting account of the changes in political status, nationality and commercial prosperity of the islands. The section dealing with the cultivation of sugar, cotton, lime products, cocoa, coconuts and tobacco is very instructive.

It would be an advantage, if, in future editions, separate maps of the principal islands on a larger scale were provided, and some of the illustrations brought more up-to-date.

P. E. TURNER.

THE COLLEGE SUGAR FACTORY.

First Report.

PROF. O. F. BOYD, B.A. (University of La.)

THE model sugar factory started operations on February 25, 1925. The factory was formally opened by His Excellency, Sir Horace Byatt, K.C.M.G., on Saturday afternoon, February 28, 1925.

The following report represents the work accomplished during the past month :—

Operating days	27	
Canes ground	855·647	long tons
Sugar bagged (504 bags of 280 lb. each)	63	,, ,,
Sugar in Crystallizers and Mixers	5	,, ,,
,, Syrup and Molasses	6	,, ,,
,, Stock in Building	4	,, ,,
Total sugar made and estimated	78	,, ,,
Tons of cane per ton of sugar	10·9	,, ,,
Average polarisation	96·5	,, ,,

Grey crystals have been the principal grade of sugar manufactured and a ready market has been found for this particular grade. The factory is operating a twenty-four hours shift and every effort has been made to put things on a commercial basis.

The students in the Department of Sugar Technology are working regular hours in the factory and laboratory and are carrying out the routine work. It is the intention of the department to grind about 2,500 tons of cane and, of course, to manufacture as much sugar as possible. This will carry the grinding season over a period of about seventy days.

COLLEGE NEWS.

The International Health Board has offered £1,000 a year for five years to establish a Chair of Tropical Sanitation and Hygiene at the College.

On Sunday, March 22nd, the College Cricket XI lost to St. Mary's College Cricket XI by 87 runs. Mr. D. R. D. Wiles obtained 4 wickets for 11 runs for the College.

Professor Ballou, acting Principal, lectured to the Tacarigua District Agricultural Society on March 26th on "Termites: The Insects and the Problems of their control."

Major Mundy, Chief Agriculturist, Department of Agriculture and Lands, Salisbury, Southern Rhodesia, has very kindly consented to act as local correspondent for *Tropical Agriculture.*

The following, among others visited the College during the month :—United Kingdom : Viscount Lee of Fareham accompanied by His Excellency the Governor of Trinidad, Mr. and Mrs. E. Pemberton, Mr. and Mrs. W. H. Godden, and Mr. Wm. I. Benson ; British Guiana : Messrs. C. W. S. Arnold, B. Layers, K. S. Arnold and Dr. and Mrs. G. H. Steven ; New York : Mr. A. J. Blakeslee ; Trinidad : Messrs. F. Stell and V. Wharton.

Since the last issue of the Journal two excursions have taken place. On March 28, second year and post graduate students journeyed to Waterloo Estate, of which Captain W. F. Watson is the General Manager. The party which included Professors Dash, Ashby and Mr. Shephard were warmly welcomed and conducted over the factory, distillery and copra drying plant. On March 30, a party of first year, and post graduate students with Professor Dash and Mr. Shephard visited Caroni Estate for the special purpose of observing the mechanical tillage being done by the Fowler system of cable ploughs and disc harrows. This was made possible through the courtesy of Mr. L. Grant, general field manager. We are greatly indebted to these estates for their valuable assistance.

With this issue of *Tropical Agriculture* we publish a supplement on Lord Milner's Appeal for funds on behalf of the Imperial College of Tropical Agriculture. The supplement contains copies of the appeals issued by Lord Milner and by Lord Burnham ; a report of the Luncheon arranged by the Appeal Committee of the College at the Mansion House on January 29th, 1925, with speeches by the Rt. Hon. L. S. Amery, M.P., Secretary of State for the Colonies, Sir Arthur Shipley, G.B.E., F.R.S., Chairman of the Governing Body of the Imperial College, Lord Burnham, C.H., Chairman of the Appeal Committee during the absence of Lord Milner in South Africa ; and The Lord Mayor. Subscriptions should be sent to the Secretary of the College, 14, Trinity Square, London, E.C. 3, or to the Bankers of the Fund, the Colonial Bank, 29, Gracechurch Street, E.C. The report of the speeches at the Mansion House Luncheon appeared in the *West India Committee Circular* of February 12, 1925.

On the afternoon of Saturday, March 21st, the College held its second annual Athletic Sports on the College Grounds. The results were as follows :—

100 yds. : H. C. Vilain, first (11 secs.) ; F. A. Robb, second, B. T. Steemson, third. Long Jump : F. A. Robb, first (19 ft. 2 ins.) (*record*) ; H. C. Vilain, second ; B. T. Steemson, third. 440 yds. : F. A. Robb, first (59-1/5 secs.) (*record*) ; H. C. Vilain, second, B. T. Steemson, third. Throwing the Cricket Ball : B. G. Montserin, first (94 yds. 1 ft. 4 ins.) (*record*) ; B. T. Steemson, second ; J. A. McDonald, third. ½ mile : B. T. Steemson, first (2 mins. 21-3/5 secs.) (*record*) ; J. A. McDonald, second ; J. B. Hutchinson third. High Jump : B. G. Montserin, first (4 ft. 11 ins.) (*record*) ; B. T. Steemson, C. Palmer, and H. C. Vilain tied for second place. 220 yds. : F. A. Robb and H. C. Vilain tied for first place (23-4/5 secs.) (*record*) ; B. T. Steemson, third. Relay Race (1,655 yds) : "Gold Coast Post Graduates" 2nd Year Diploma Students Combined team tied with the 1st Year Diploma Students Team for first place (3 mins. 42-2/5 secs.) (*record*) ; "Empire Cotton Growing Corporation Post Graduates," third. Tug-of-War : "Empire Cotton Growing Corporation Post Graduates," first ; "Gold Coast Post Graduates" and 2nd Year Diploma Students Combined Team, second. Won by 2 tugs to nil. 1 mile : J. B. Hutchinson, first ; (5 mins. 57-1/5 secs.) (*record*) ; F. A. Robb, second. Obstacle Race : J. A. Potter, first, J. C. Muir, second.

The events were very keenly contested and in each, with the exception of the 100 yds., a record was established. Of the eight records, five were improvements upon those made last year, while those for the Relay Race, Throwing the Cricket Ball, and the 1 mile were for events introduced for the first time this year. The 220 yds. and the Relay Race resulted in a dead heat for the first place. F. A. Robb deserves special mention for his running in the final 220 lap of the Relay Race in which he started more than 15 yards behind his opponent, but by an excellent effort secured a tie for the "Gold Coast Post Graduates" and 2nd Year Diploma Students Combined Team.

For the "Victor Ludorum" Cup points were awarded in each event as follows : First place, three points ; second place, two points ; third place, one point. F. A. Robb secured the cup with a total of 13 points, H. C. Vilain, winner of the "Victor Ludorum" Cup last year, was second with 12 points, and B. T. Steemson, third with 11 points. Other competitors obtained the following points : B. G. Montserin, 6 ; J. B. Hutchinson, 4 ; J. A. McDonald, 3 ; and C. Palmer, 2.

The officials were : Judges, Prof. H. A. Ballou and Mr. A. G. Howell. Time Keepers, Messrs. E. E. Cheesman and P. E. Turner. Starter, Mr. C. Y. Shephard. Announcer, Mr. F. S. Parsons. Recorder, Mr. J. G. Davies.

Relatives and friends of the Students and College Staff attended. Mrs. H. Martin Leake presented the prizes.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Greater steadiness has been experienced during the past month and very little change in price levels has been experienced. The moderate level of prices has led buyers to demonstrate greater confidence. Even after allowing for an increase in the world's consumption it is probable that there will be a large carry over at the end of the year. Stocks in bond, London, still exceeded 4,000,000 cwt. on March 11 forming an effective guarantee of moderate prices.

COTTON.—The advance noted in our last issue has been continued and Middling American reached 14·24*d.* per lb. spot, London, on March 5. The market continues to show a good undertone and although cotton has come "into sight" very quickly it has "gone out of sight" just as rapidly.

CACAO.—The fall in prices during the beginning of February stimulated buying during the first half of the month and although prices were maintained during the second half the market was dull. Prices realised on March 4, were 110*s.* for Ceylon ordinary, 82*s.* 6*d.* for the Trinidad Mid. Red, 62*s.* 6*d.* for Grenada Fine, and 37*s.* 9*d.* for Accra fermented, each per cwt., London. Stocks are moderate and less than a year ago, being 587,000 cwt. as against 713,000 cwt.

COFFEE.—All grades have shown a downward tendency, and the market is rather dull. On March 4, Costa Rica Middling realised 170*s.* East Indian Middling Mysore 164*s.*, Kenya Good Middling 146*s.* and Brazil Santos 126*s.* each per cwt., London. Stocks in London are moderate totalling 178,000 cwt. on March 4.

TEA.—The decline in prices noted last month continued until February 18, after which date a general improvement took place. Prices on March 4 averaged 20·00*d.* for Ceylon, 18·34*d.* for Indian and 13·89*d.* for Java, each per lb. Some very poor Kaligoa tea at 8*d.* and Tjisalak at 10*d.* helped to depress the Java average. Cargoes are much larger than usual and, in the absence of any control of packages offered for auction, some temporary decline must be anticipated.

SISAL AND HEMP.—Manila hemp fell further to £49 per ton on February 18, but rapidly advanced to £54 10*s.* on February 25, and closed at £53 on March 3. Prime Sisal fell to £44 10*s.* on February 18, but closed at £47 on March 4.

RUBBER.—Rubber is appreciably stronger. The average price has risen from 17·20*d.* per lb. on February 11 to 17·43*d.* per lb. on March 4, while stocks in London have fallen to 25,000 tons which must be considered the lowest level compatible with safety.

RICE.—Carolina rice had risen to 37*s.* per cwt. on March 4, but Burmese remained at 18*s.* nominal.

COPRA.—Prices declined to £30 5*s.* per ton for Ceylon Copra £29 7*s.* 6*d.* for sun dried Straits to Rotterdam.

OILCAKE.—There has been no appreciable change in prices since our last issue.

FERTILISERS.—Prices remain steady at last months' level.

SPICES, NUTMEGS and MACE have registered substantial advances, West Indian nutmegs being quoted at 2*s.* to 2*s.* 1*d.* London and 50 *cents* New York per lb. on March 3 and Mace 3*s.* 3*d.* and 3*s.* 6*d.* per lb. London and 92 *cents* New York. Although the buying demand is limited stocks are so low that further advances are to be expected. Jamaican Ginger realises low prices 21 *cents* New York being obtained on March 3; stocks are increasing and lower prices are anticipated.

RUBBER.

Costs of Production.

IN their annual report and forecast Messrs. Symington & Sinclair (17, Mincing Lane, London, E.C. 3.) give some interesting comparisons of the cost of production of rubber from some 221 rubber planting companies.

	1922-23		1923-24	
	Crop (Tons.)	*All-in Cost (Pence per lb.)*	*Crop (Tons.)*	*All-in Cost. (Pence per lb.)*
140 Malayan Coys.	37,622	8·68	33,720	9·68
33 Dutch East Indies Coys.	11,257	9·22	10,890	9·13
28 Ceylon Coys.	8,111	7·60	6,509	9·01
20 Coys. with Plantations elsewhere than as above	9,116	9·07	5,042	8·46

It will be observed that under the Restriction of Exports Regulations costs of production in Malaya have increased by exactly 1*d.* per lb. and in Ceylon by 1·41*d.* per lb. In the Dutch East Indies, on the other hand, where some companies voluntarily restrict their output, although there is no fundamental change in costs of production it will be noted that there is a tendency towards a slight reduction. These figures make no allowance for interest on capital, dividends or depreciation.

"TROPICAL AGRICULTURE"

Imperial College of Tropical
Agriculture,

Trinidad.

Dear Sir,

Since January 1st. 1925 the number of subscribers to "Tropical Agriculture" has trebled. The success achieved has convinced us that the Journal needs only to be brought to the notice of a wider circle for its circulation to be still considerably increased, and in this connection we beg of your kind co-operation. If you will be good enough to send us by postcard or letter, the names and addresses of any of your friends (without limitation of numbers) who are interested in tropical development, we shall be pleased to send them, in due course, a gratuitous specimen copy of "Tropical Agriculture" for their perusal.

Thanking you in anticipation,

I remain,

Yours faithfully,

Editor.

"The Plant Industry"

Imperial College of Tropical
Agriculture,

Trinidad.

Dear Sir,

Since January 1st, 1934 the number of subscriptions to "Tropical Agriculture" has trebled. The success achieved has convinced us that the journal needs only to be brought to the notice of a wider circle for its circulation to be still considerably increased, and in this connection we beg of your kind co-operation. If you will be good enough to send us by return of post, the names and addresses of any of your friends (without the knowledge of members) who are interested in tropical agriculture, we shall be pleased to send them, in the course of a few days, a specimen copy of "Tropical Agriculture" for their perusal.

Thanking you in anticipation,

I remain,

Yours faithfully,

Editor.